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ABSTRACT

This profusely illustrated activity book helps students understand systems and cycles, how years change the look of the Earth, and how students can protect resources. The sections (and activities) in this book are: (1) The Earth (Introduction--View, Soil & Dirt); (2) Forces (Plate Tectonics, Earthquakes, Mountain Building, Erosion, Volcanoes, Glaciers, River Power); (3) Measuring (Natural Layers, Ages & Stages, Measuring Time, Ocean Floor, Ground Water); (4) Mapping (Making Maps, Different Maps, Mapping Game, Geo Jobs, U.S. Map); (5) Geology (Fascinating Finds, Expedition Game, Weather: Outside; Pressure: Inside; Weathering; Minerals; Tools & Tests; Rock Hounds Game); (6) From the Ground (Yesterday's Resources, Today's Products, Precious Stuff, Dinosaurs, World of Fossils, Making Fossils); and (7) The World (World Geography, Curious Page, Rocks in Space, City/Country Geology, Recycling and Pollution, See in Metrics). (PR)

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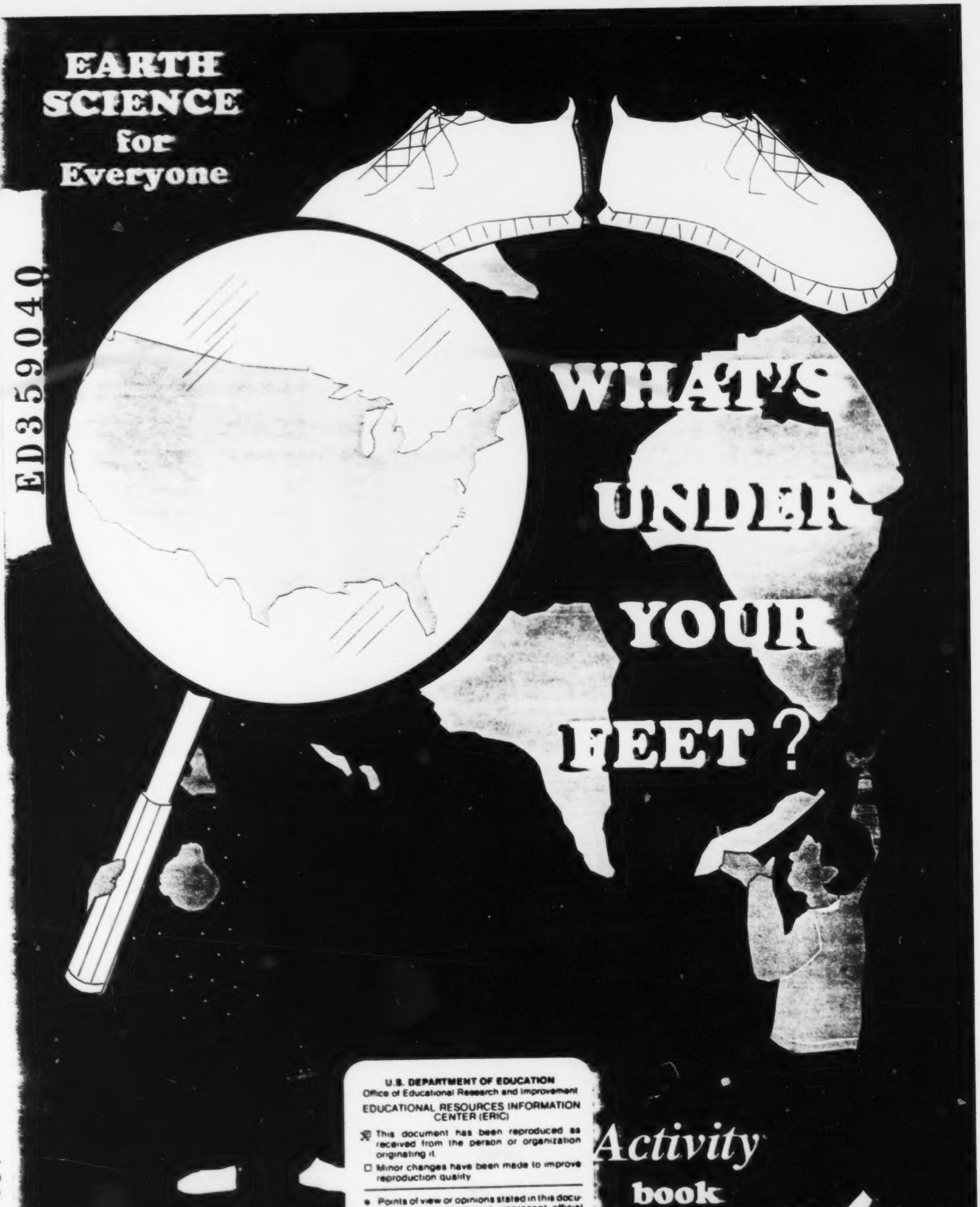
EARTH SCIENCE for Everyone



WHAT'S UNDER YOUR FEET?

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Activity book

U.S. DEPARTMENT OF THE INTERIOR/U.S. GEOLOGICAL SURVEY

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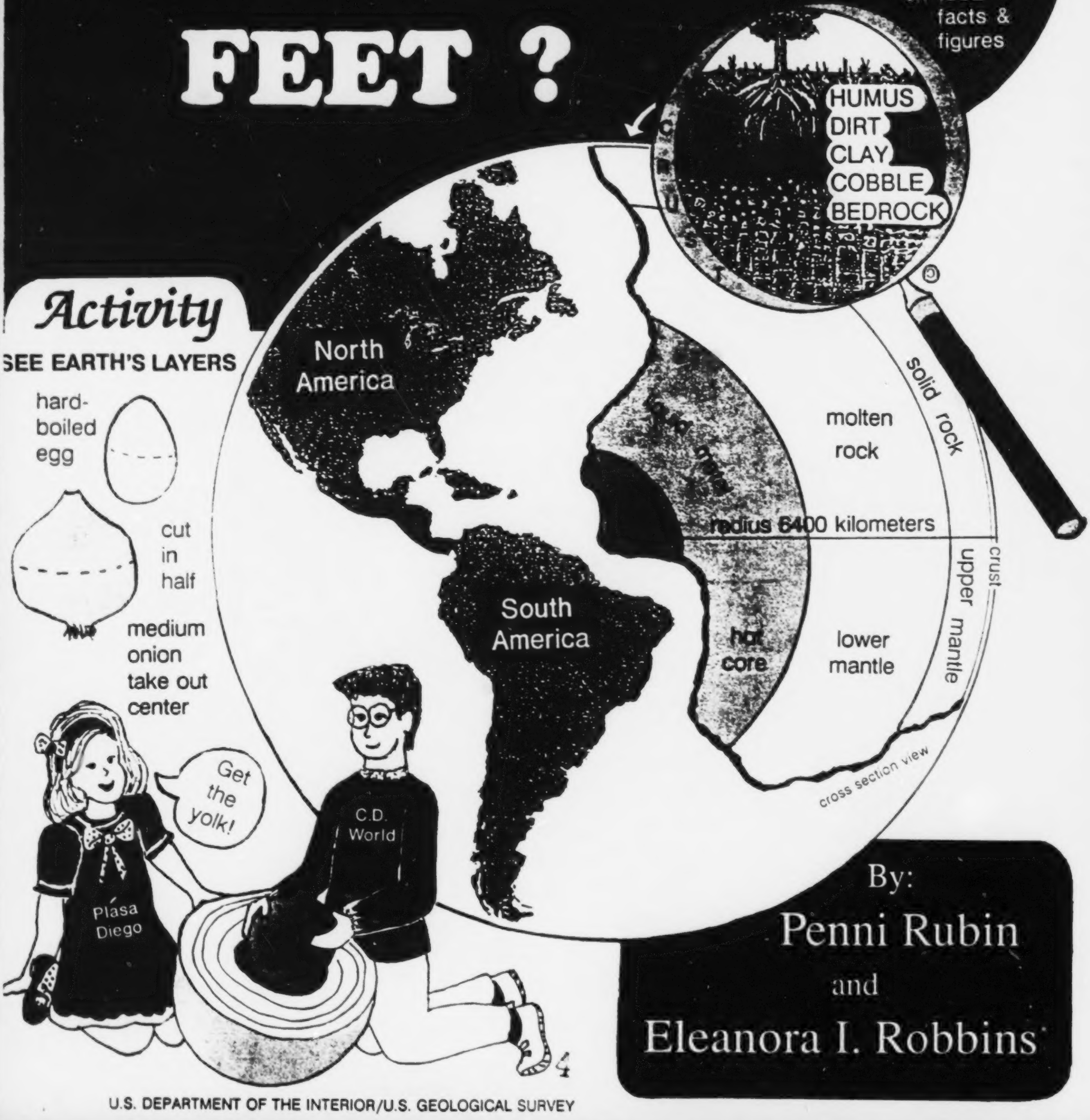
WHAT'S UNDER YOUR FEET ?

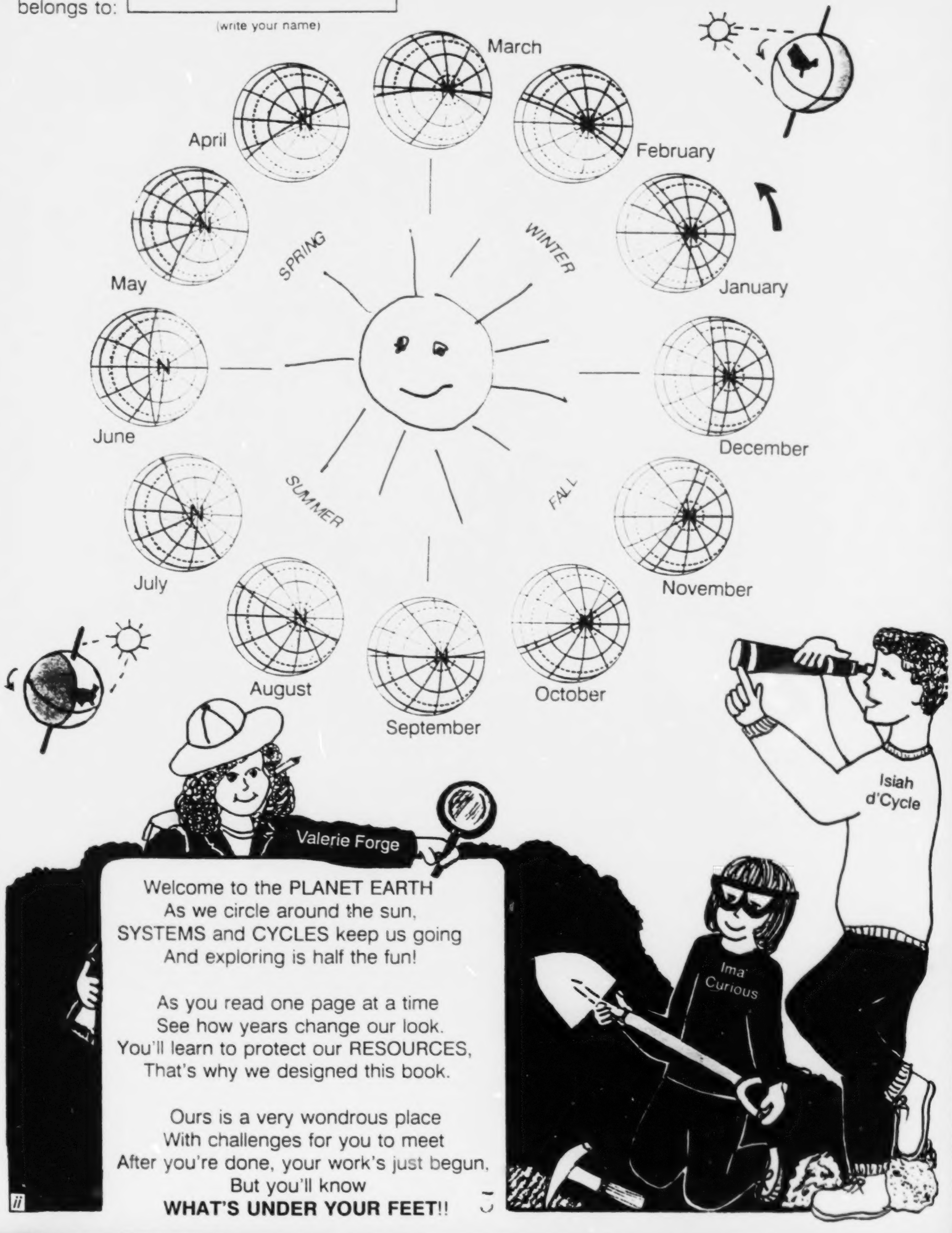
Based on 1992 facts & figures


HUMUS
DIRT
CLAY
COBBLE
BEDROCK
Activity
SEE EARTH'S LAYERS
hard-boiled egg
cut in half
medium onion take out center
North America
South America
liquid outer
molten rock
solid rock
radius 6400 kilometers
crust
upper mantle
hot core
lower mantle
cross section view
Get the yolk!
C.D. World
Plasa Diego
4

By:
Penni Rubin
and
Eleanora I. Robbins

U.S. DEPARTMENT OF THE INTERIOR/U.S. GEOLOGICAL SURVEY

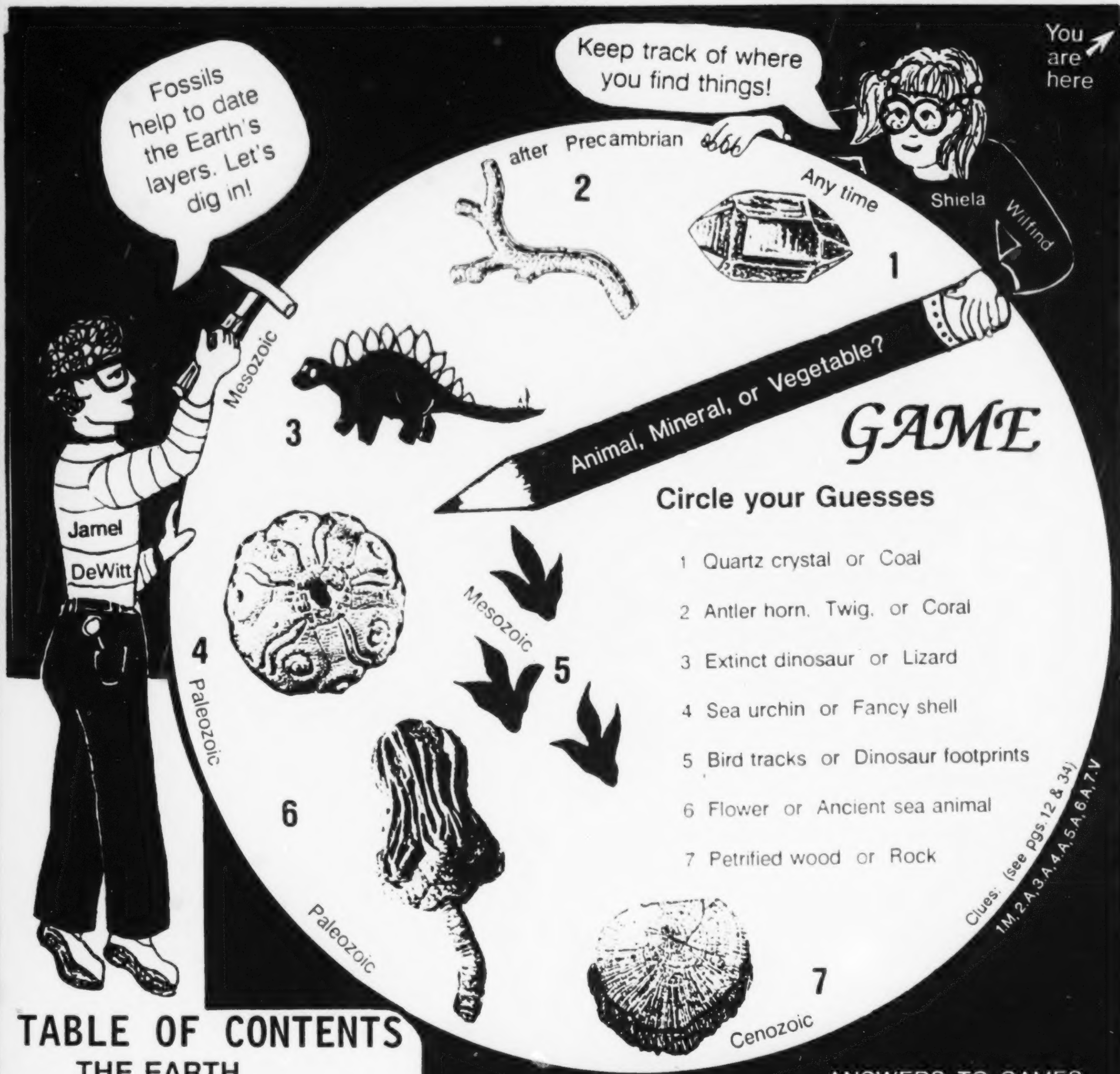
This Earth belongs to: ____________________
(write your name)


March
February
January
December
November
October
September
August
July
June
May
April
SPRING
WINTER
SUMMER
FALL
N
Valerie Forge
Ima Curious
Isiah d'Cycle

Welcome to the PLANET EARTH
As we circle around the sun,
SYSTEMS and CYCLES keep us going
And exploring is half the fun!

As you read one page at a time
See how years change our look.
You'll learn to protect our RESOURCES,
That's why we designed this book.

Ours is a very wondrous place
With challenges for you to meet
After you're done, your work's just begun,
But you'll know
WHAT'S UNDER YOUR FEET!!


Fossils help to date the Earth's layers. Let's dig in!
Keep track of where you find things!
after Precambrian
2
Any time
1
Shiela Wilfind
Mesozoic
3
Animal, Mineral, or Vegetable?
Jamel DeWitt
4
Paleozoic
Mesozoic
5
6
Paleozoic
7
Cenozoic

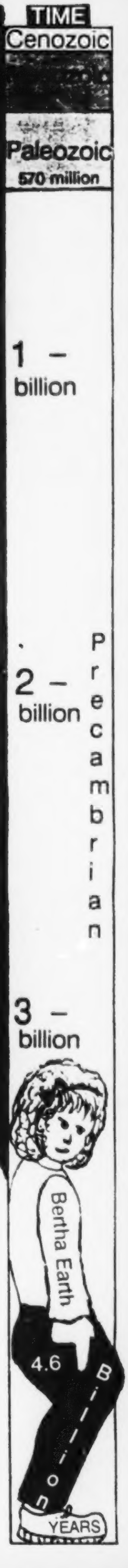
GAME

Circle your Guesses

1 Quartz crystal or Coal
2 Antler horn, Twig, or Coral
3 Extinct dinosaur or Lizard
4 Sea urchin or Fancy shell
5 Bird tracks or Dinosaur footprints
6 Flower or Ancient sea animal
7 Petrified wood or Rock

Clues: (see pgs. 12 & 34)
1.M, 2.A, 3.A, 4.A, 5.A, 6.A, 7.V

ANSWERS TO GAMES
are inside back cover


TIME
You are here
Cenozoic
Paleozoic
570 million
1 - billion
2 - billion
Precambrian
3 - billion
Bertha Earth
4.6
Billion
YEARS

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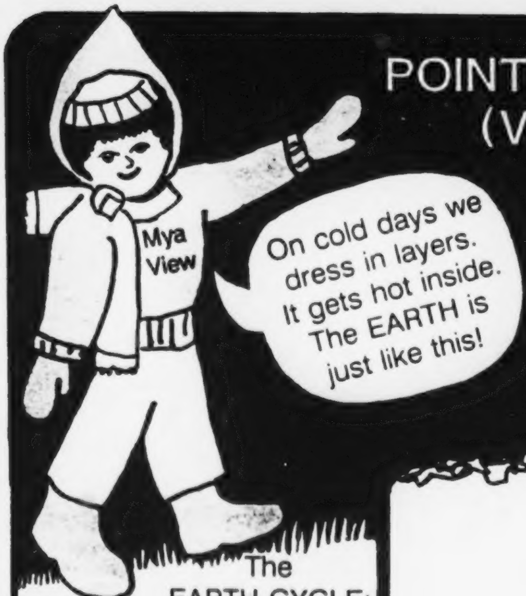
POINT OF YOU (VIEW)

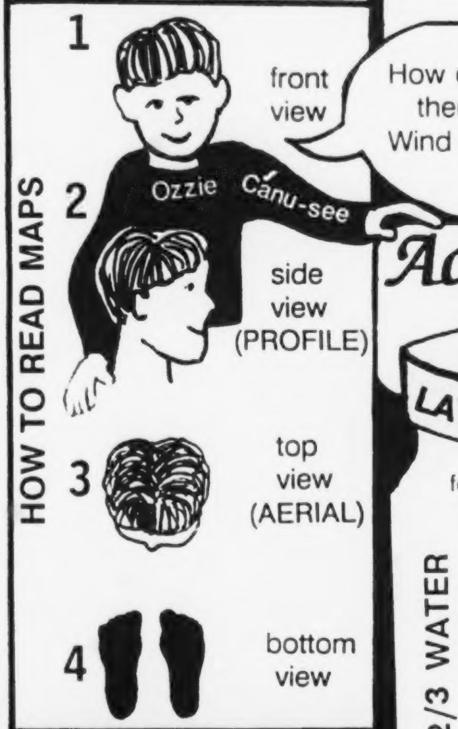

Mya View
On cold days we dress in layers. It gets hot inside. The EARTH is just like this!

DRAW WHAT'S UNDER YOUR FEET

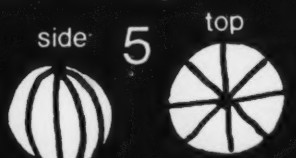
The EARTH CYCLE:

Today's LAYER becomes Tomorrow's ROCKS, and Yesterday's BEDROCK is Today's SOIL. (see pg. 24-26)

HOW TO READ MAPS

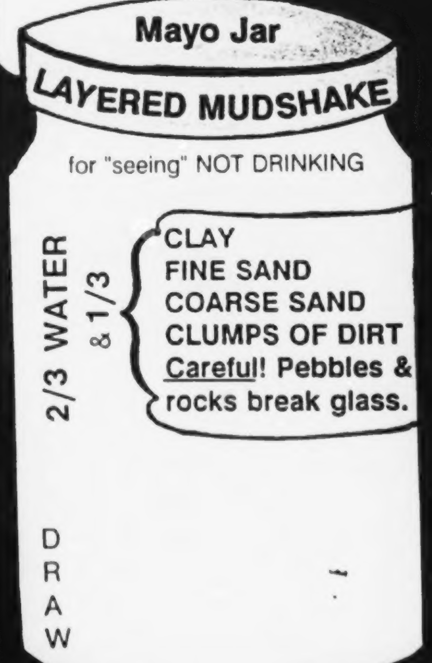

1
front view
2
Ozzie Cánu-see
side view (PROFILE)
3
top view (AERIAL)
4
bottom view
How did the stuff in your yard get there? Trucks or bulldozers? Wind or rain? Glaciers or oceans? What do you think? ?

Picture an orange



CROSS SECTION

Activity



Mayo Jar

LAYERED MUDSHAKE

for "seeing" NOT DRINKING

2/3 WATER & 1/3

- **CLAY**
- **FINE SAND**
- **COARSE SAND**
- **CLUMPS OF DIRT**

Careful! Pebbles & rocks break glass.

D R A W

Terra Topsoil

In a jar with water, MIX 2 or 3 of these dirts at a time. STIR with a wooden spoon and let SETTLE one day.

Get dirt from other places & try new combos. Can you guess which will reach the bottom first?

The deepest we've ever drilled is 12 km (7.5 mi). Then the heat of the Earth ruined the equipment. (Peek at pg.25.)

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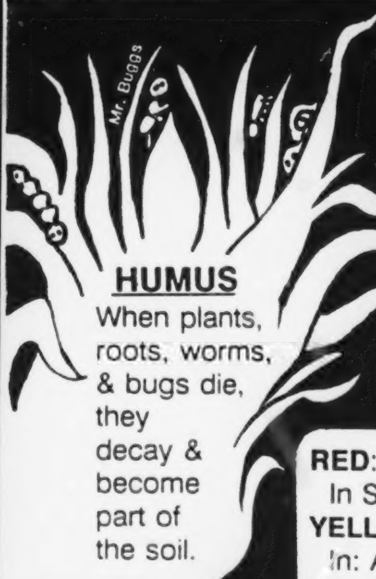
Activity

Some **SOILS** hold & drain water better than others.

Get some cups and fill each with a different type of **SEDIMENT** (clay, sand, small rocks, top soil). Plant a few grass seeds in each cup. Measure & use the same amount of water. Keep a record of the growth rates in each of your samples. In which soil do you get better results?



HUMUS

When plants, roots, worms, & bugs die, they decay & become part of the soil.

EARTHTONES

RED: contains iron
In States (pg.21): AL,CO,GA,MN,SC
YELLOW: contains sulfur or iron
In: AR,LA,MI,ND,NV,SD,TX,WY
WHITE: broken shells, sand, or snow
In: AK,AZ,CA,FL,IN,MT,NM,UT
BROWN: humus,sandstone, or wetlands
In: CT,DE,ID,IL,MA,ME,MD,MS,NH,NJ,NY,NC,OH,OK,OR,RI,TN,VA,VT,WV
BLACK: volcanic lava, coal, or loam
In: HI,IA,KS,KY,MO,NE,PA,WA,WI

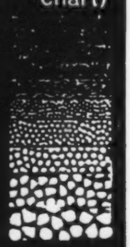
Rocks break up in many different sizes to make soil. Lighter grains stay near the top & heavier go to the bottom. Fine-grained clay & mud layers settle and become COMPACTED to make rocks again!

Kevin
Mudd
Get Down to Earth

SOIL & DIRT

Dig a hole. What color is your dirt (first layer)? Dig somewhere else. Is it the same color? Dig deeper; check the sizes, colors, and areas on the charts of this page.

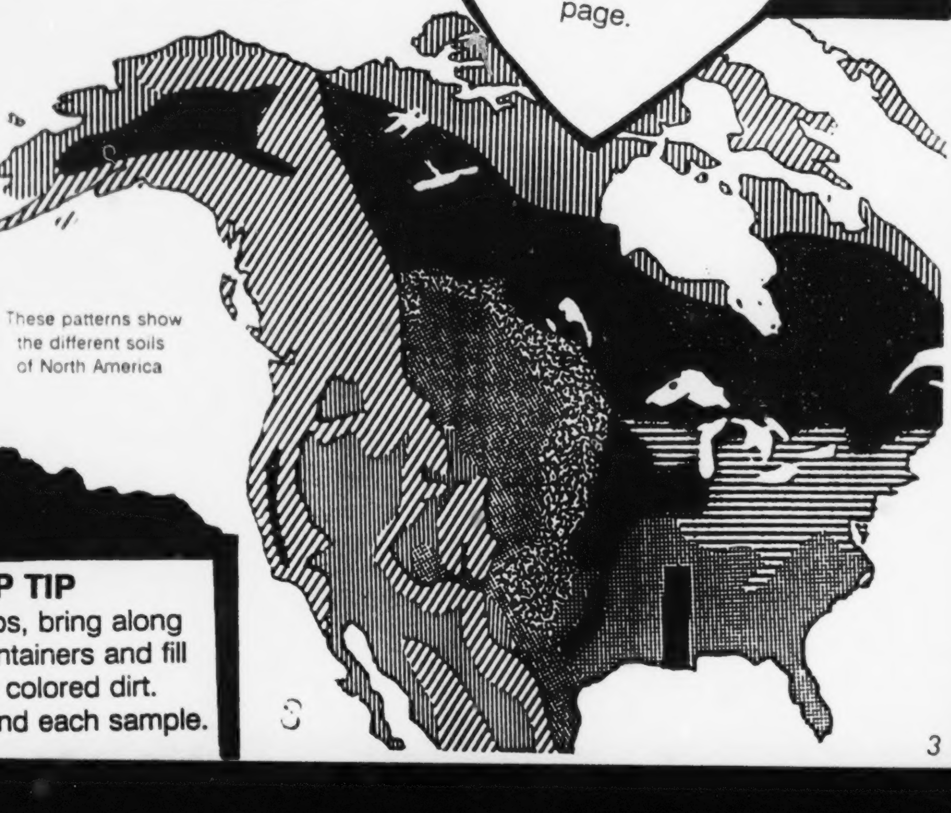
SIZES
(actual chart)



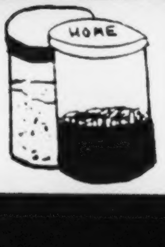
Loam

Earthy materials like sand and clay.

ORGANIC MATTER like this helps Earth create coal, oil, & gas.



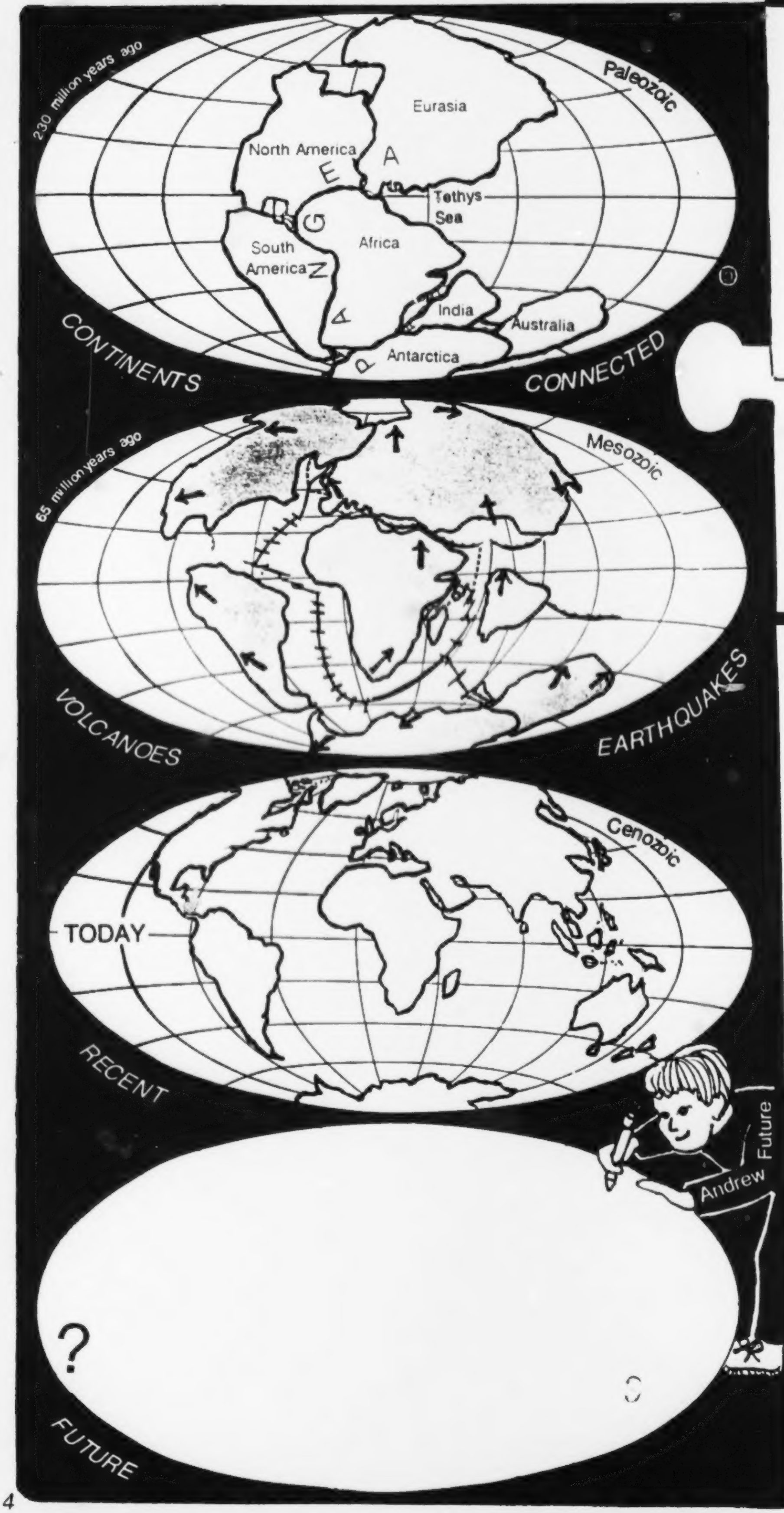
These patterns show the different soils of North America



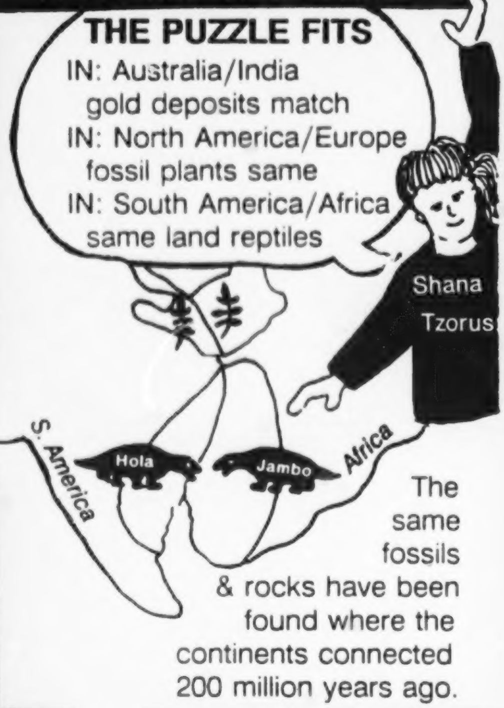
FUN TRIP TIP

When going on trips, bring along clear film or pill containers and fill them with different colored dirt. Label where you find each sample.

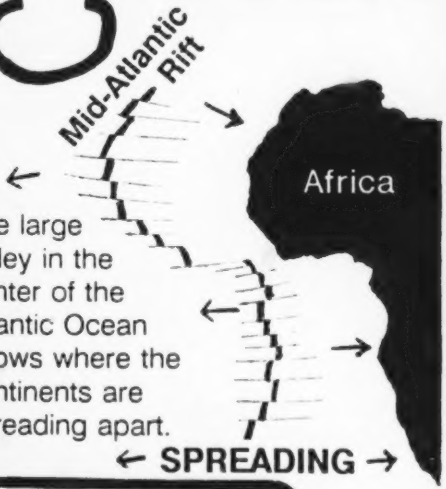
THE STORY OF PANGEA


230 million years ago
Paleozoic
Eurasia
North America
South America
Africa
India
Australia
Antarctica
Tethys Sea
PANGEA
CONTINENTS CONNECTED
65 million years ago
Mesozoic
VOLCANOES EARTHQUAKES
Cenozoic
TODAY
RECENT
Future
Andrew
?
FUTURE

HOW DO WE KNOW


THE PUZZLE FITS
IN: Australia/India gold deposits match
IN: North America/Europe fossil plants same
IN: South America/Africa same land reptiles
Shana Tzorus
S. America
Africa
Hola
Jambo

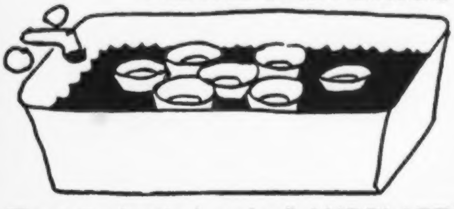
The same fossils & rocks have been found where the continents connected 200 million years ago.


Mid-Atlantic Rift
Africa
← SPREADING →

The large valley in the center of the Atlantic Ocean shows where the continents are spreading apart.

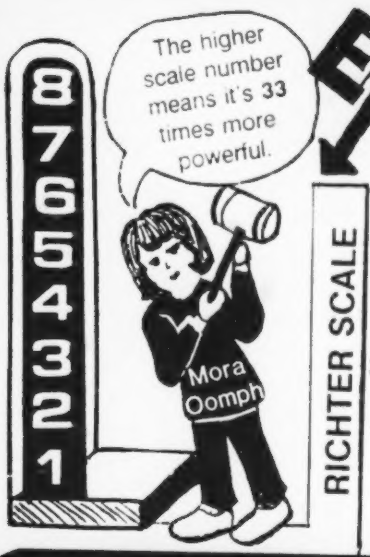
Activity

PLATE TECTONICS



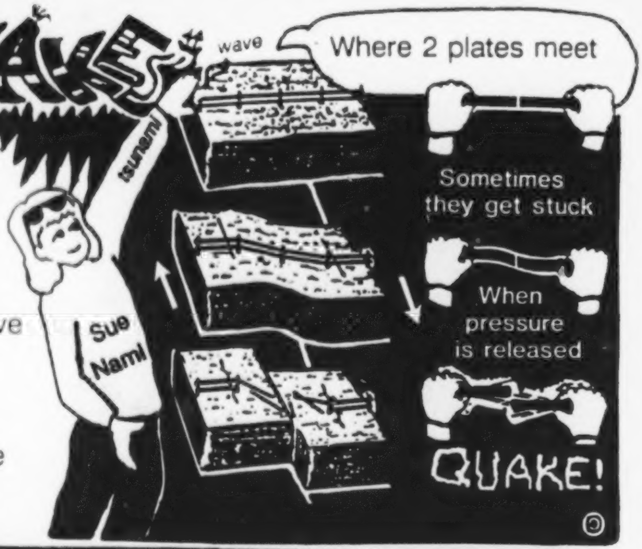
Float 7 plastic bowls (LANDPLATES in the bathtub. Try to keep them together and wiggle the water (EARTHQUAKES). Watch how they float apart (CONTINENTAL DRIFT) & crash (MOUNTAIN BUILDING).

EARTHQUAKES

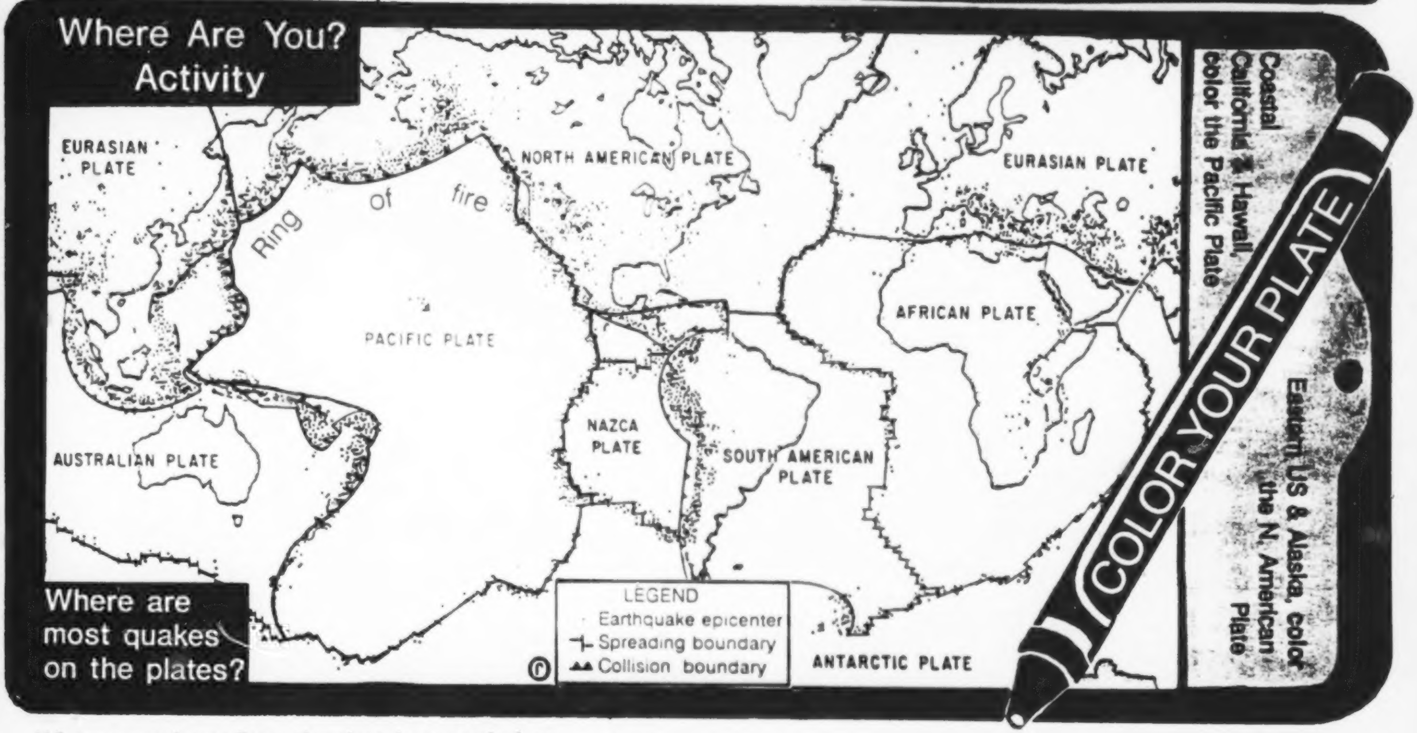

8 7 6 5 4 3 2 1
The higher scale number means it's 33 times more powerful.
Mora Oomph
RICHTER SCALE

PEOPLE SCALE

8 - total damage
7 - buildings fall down
6 - buildings crack and things fall off shelves
5 - furniture & pictures move
3-4 - feel rumble in floor & hear noise overhead!
1-2 - you will not feel these (Some people are more sensitive and feel the smaller VIBRATIONS!)

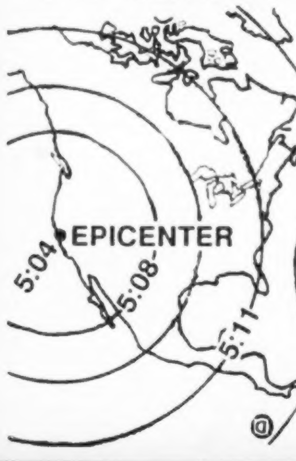

wave
Where 2 plates meet
tsunami
Sue Nami
Sometimes they get stuck
When pressure is released
QUAKE!

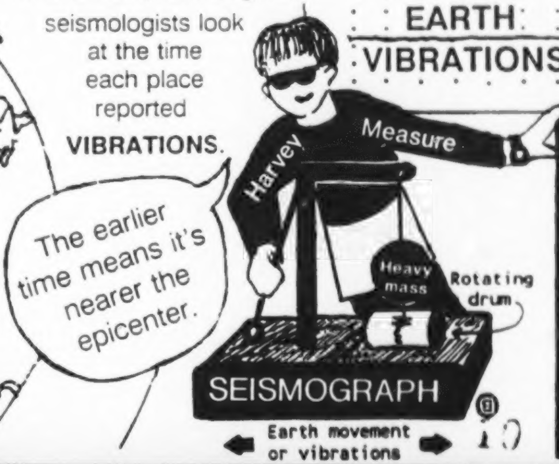
Where Are You? Activity

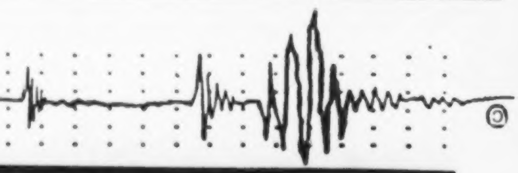

EURASIAN PLATE
NORTH AMERICAN PLATE
EURASIAN PLATE
Ring of fire
PACIFIC PLATE
AFRICAN PLATE
NAZCA PLATE
SOUTH AMERICAN PLATE
AUSTRALIAN PLATE
ANTARCTIC PLATE
LEGEND
Earthquake epicenter
Spreading boundary
Collision boundary
COLOR YOUR PLATE
Coastal California & Hawaii, color the Pacific Plate
Eastern US & Alaska, color the N. American Plate

Where are most quakes on the plates?

When a quake strikes, the time is recorded on machines (**SEISMOGRAPHS**) in many places. To find the **EPICENTER** where the quake begins, seismologists look at the time each place reported **VIBRATIONS**.


EPICENTER
5:04
5:08
5:11

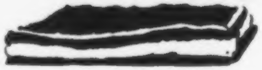

EARTH VIBRATIONS
Harvey Measure
The earlier time means it's nearer the epicenter.
Heavy mass
Rotating drum
SEISMOGRAPH
Earth movement or vibrations



FAMOUS EARTHQUAKES

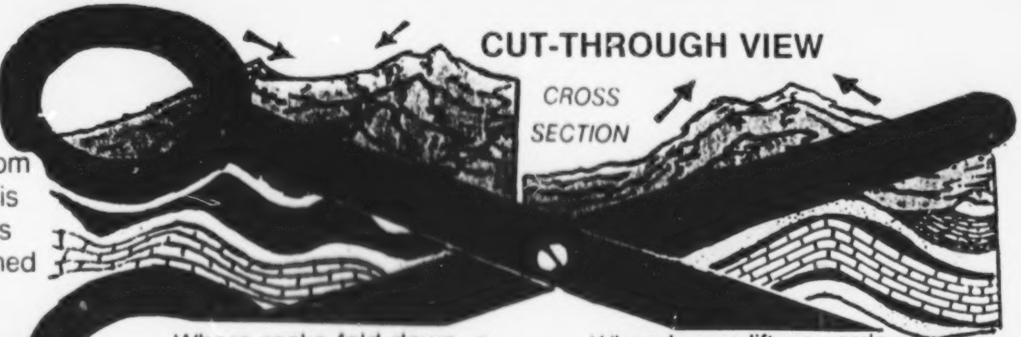
magnitude		year
8.8	New Madrid, MO	1812
8.7	Assam, India	1897
8.5	Southern Chile	1960
8.4	Anchorage, AK	1964
8.3	San Francisco, CA	1906
8.2	Tokyo, Japan	1923
7.8	T'angshan, China	1976
7.8	Chimote, Peru	1970
7.1	Loma Prieta, CA	1989
6.8	Armenia, USSR	1988

MOUNTAIN BUILDING



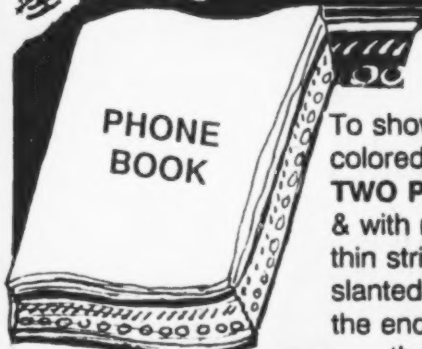
FOLDING AND FAULTING

The Earth is always moving because PRESSURE & HEAT from inside builds & moves the land plates. Sometimes one plate is affected & heat LIFTS or FOLDS the layers. Where two plates meet, they push or crash. Our highest mountain ranges formed where two plates crashed into each other! It takes a long time for these things to happen.



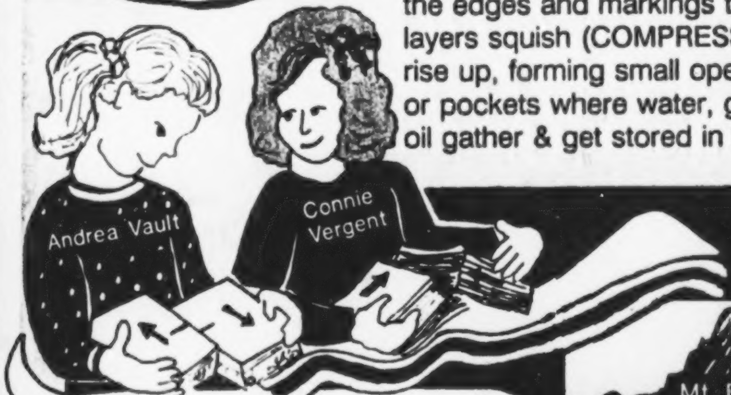
Where rocks fold down, a v-shaped valley (SYNCLINE) is formed between peaks.

When layers lift upwards (ANTICLINE), they can be even (SYMMETRICAL) or uneven (ASYMMETRICAL).



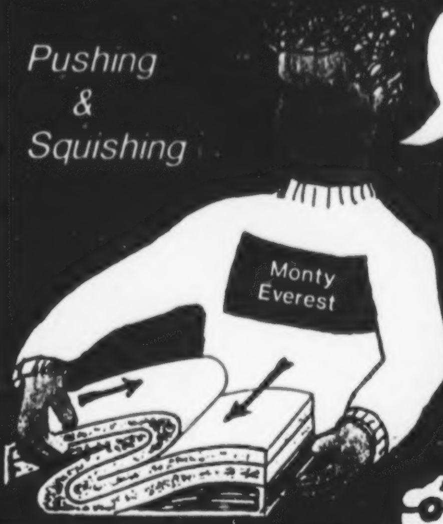
Activity

To show **ONE PLATE** action, fold three colored towels the long way. To show **TWO PLATE** action, use 2 phone books, & with markers, make rows of thick and thin stripes, small circles, and diagonal slanted lines on sides. When you push the ends of the towels and books, watch the edges and markings to see the layers squish (COMPRESS) or rise up, forming small openings or pockets where water, gases, and oil gather & get stored in the Earth.



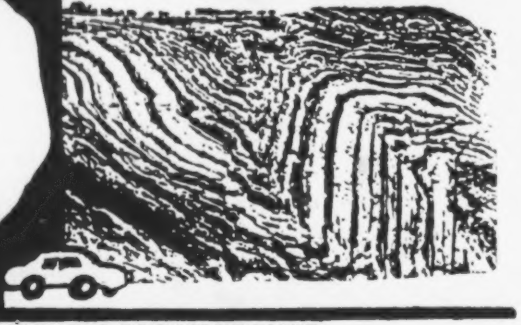
Draw a line on top of two phone books, slide one to you and one away (**FAULT**). The San Andreas Fault is where two land plates slide apart.

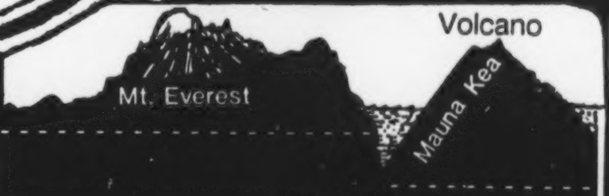
Push books together and see uplifting (**CONVERGENCE**).



When one plate slides under another plate (SUBDUCTION), heat gets through and VOLCANOES appear.

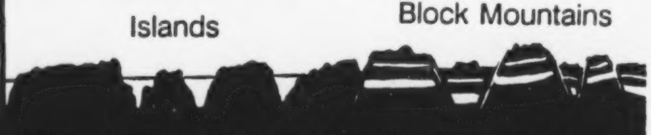
EARTHQUAKE FOLDING





The highest mountain in the world is not Mt. Everest (8,800 meters), but Mauna Kea, a volcano in Hawaii. It measures 9,800 meters from its top to its bottom below the

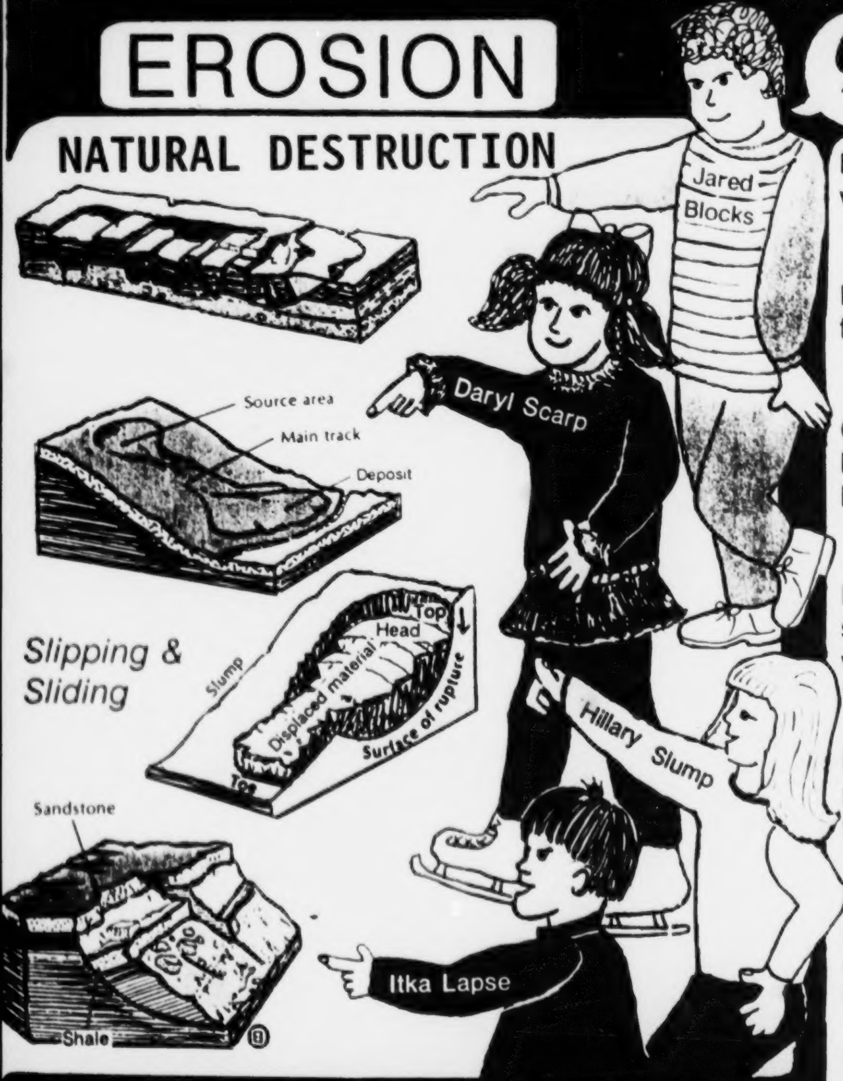
PROFILES OF MOUNTAINS



When driving past cut-through mountains, look at the LAYERS in the rocks. If you see folds, you know the rocks were under great PRESSURE. If you see round stones, you know

EROSION

NATURAL DESTRUCTION


Jared Blocks
Source area
Main track
Deposit
Daryl Scarp
Top
Head
Slump
Displaced material
Surface of rupture
Toe
Slipping & Sliding
Hillary Slump
Sandstone
Shale
Itka Lapse

The rock beds in some layers are softer and break up, weathering easily. When bare rocks get wet and icy, the looser ones and even whole layers can fall down. BLOCK MOUNTAINS show how layers get rearranged when they slide and leave a SCARP. Storms and glaciers wear away at the top layers and water can seep in. Sometimes rocks & sediments hold water inside. Freezing and thawing action moves rocks too. Earthquakes & storms can start SLUMPS, LANDSLIDES, & AVALANCHES. (See pg. 24.)

GAME

TO PLAY: Decide if each is happy or sad →

	☺	☹
Plants help hold water and make soil richer.	○	○
Burning the rain forests exposes bare land to erosion.	○	○
Over-grazed land has few plants to hold soil and water.	○	○
Mud fences at building sites keep soil from washing away into streets and streams.	○	○
It takes years for soil of barren land to build so plants can grow.	○	○
Land developers cut down trees to build new buildings.	○	○
Less forest land means less plants and dirtier air.	○	○
More city means less land for wild animals.	○	○
Roads cut through the natural places help to create erosion.	○	○

MAN-MADE DESTRUCTION

T or F?

Layers of plastic and garbage slow down Earth's natural decaying activity.

Oil spills hurt the animals and plants on land & in the water.

Toxic wastes seep into our drinking water supply.

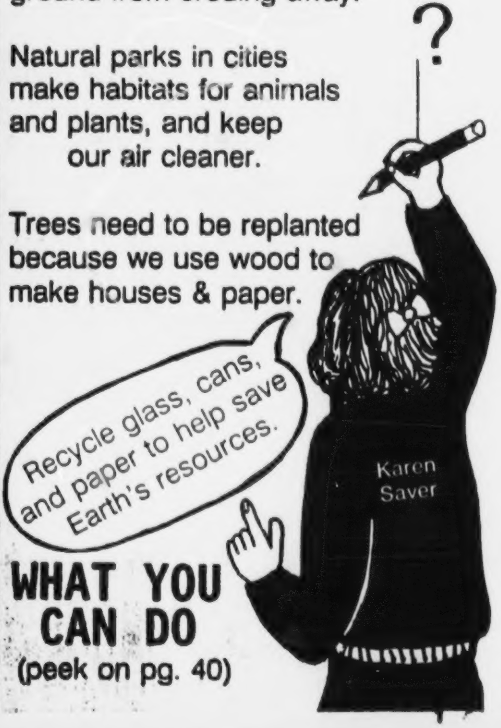
Swamp, marsh, and bog wetlands keep our water clean.

HELPING HANDS

Plantings help to keep the ground from eroding away.

Natural parks in cities make habitats for animals and plants, and keep our air cleaner.

Trees need to be replanted because we use wood to make houses & paper.

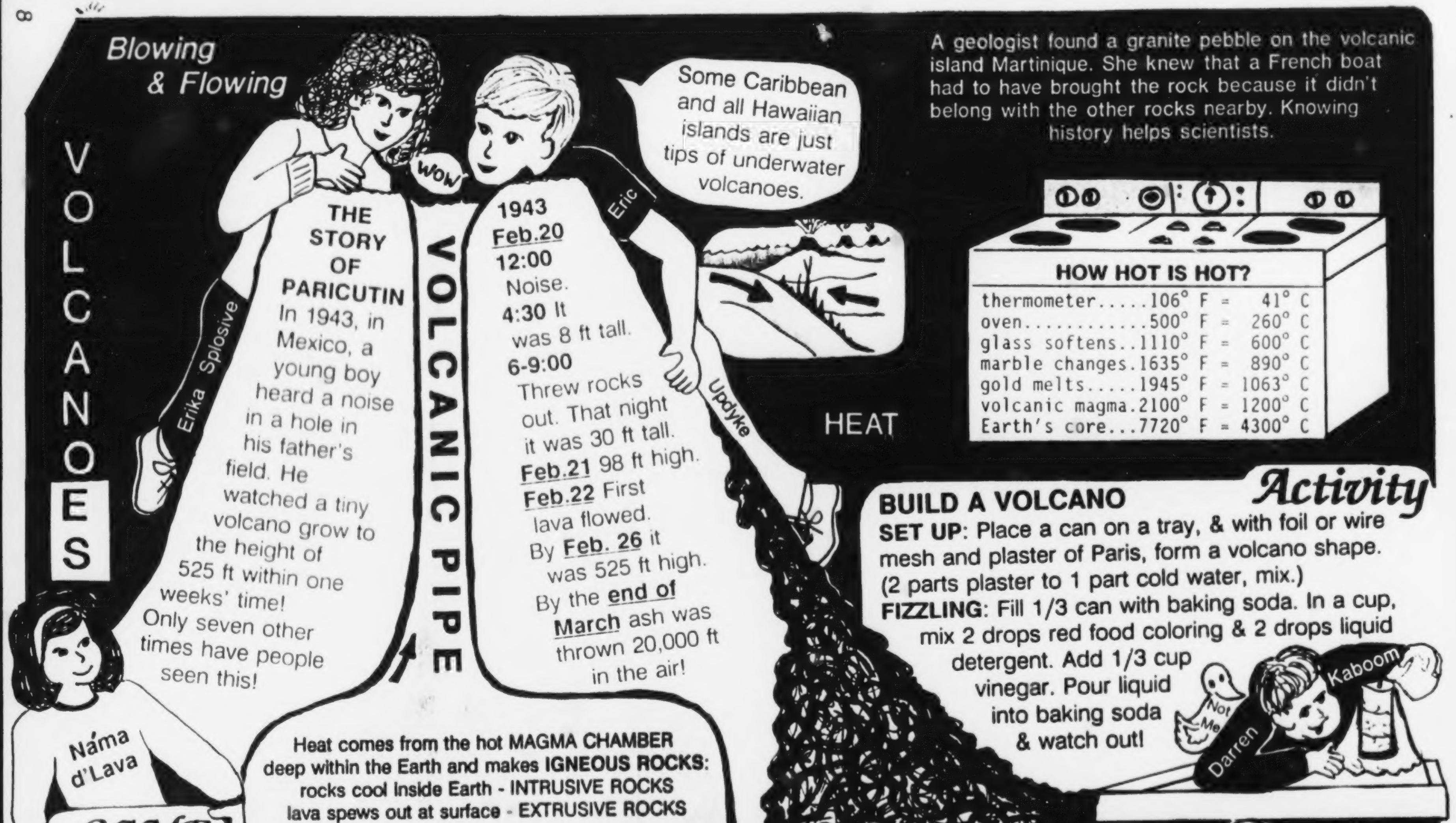

?
Recycle glass, cans, and paper to help save Earth's resources.
Karen Saver

WHAT YOU CAN DO

(peek on pg. 40)

VOLCANOES

Blowing & Flowing



THE STORY OF PARICUTIN

In 1943, in Mexico, a young boy heard a noise in a hole in his father's field. He watched a tiny volcano grow to the height of 525 ft within one weeks' time! Only seven other times have people seen this!

1943
Feb.20
12:00 Noise.
4:30 It was 8 ft tall.
6-9:00 Threw rocks out. That night it was 30 ft tall.
Feb.21 98 ft high.
Feb.22 First lava flowed.
By **Feb. 26** it was 525 ft high.
By the **end of March** ash was thrown 20,000 ft in the air!

Heat comes from the hot MAGMA CHAMBER deep within the Earth and makes IGNEOUS ROCKS:
rocks cool inside Earth - INTRUSIVE ROCKS
lava spews out at surface - EXTRUSIVE ROCKS

Some Caribbean and all Hawaiian islands are just tips of underwater volcanoes.

A geologist found a granite pebble on the volcanic island Martinique. She knew that a French boat had to have brought the rock because it didn't belong with the other rocks nearby. Knowing history helps scientists.

HOW HOT IS HOT?

thermometer	106° F	41° C
oven	500° F	260° C
glass softens	1110° F	600° C
marble changes	1635° F	890° C
gold melts	1945° F	1063° C
volcanic magma	2100° F	1200° C
Earth's core	7720° F	4300° C

Activity

BUILD A VOLCANO

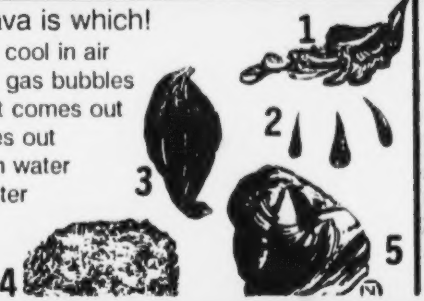
SET UP: Place a can on a tray, & with foil or wire mesh and plaster of Paris, form a volcano shape. (2 parts plaster to 1 part cold water, mix.)

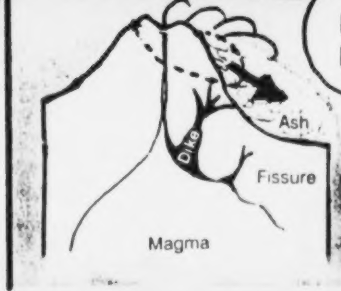
FIZZLING: Fill 1/3 can with baking soda. In a cup, mix 2 drops red food coloring & 2 drops liquid detergent. Add 1/3 cup vinegar. Pour liquid into baking soda & watch out!

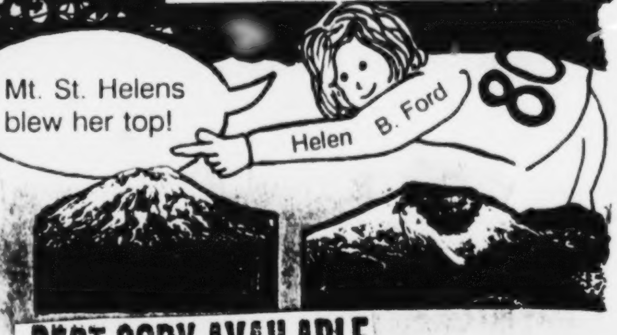
GAME

TO PLAY: guess which lava is which!

- ☐ **PELE'S TEARS**: Tiny glass blobs that cool in air
- ☐ **OBSIDIAN**: Looks like glass & has no gas bubbles
- ☐ **ROPY (PAHOEHOE)**: Is runny when it comes out
- ☐ **BLOCKY (AA)**: Is sticky when it comes out
- ☐ **PUMICE**: Has gas bubbles & floats on water
- ☐ **PILLOW**: Erupts & puffs out under water
- ☐ **LAVA**: When it flows out hot & liquid
- ☐ **ASH**: Tiny broken pieces of glass
- ☐ **BOMB**: Thrown out & cools in air






Mt. St. Helens blew her top!
Helen B. Ford
80

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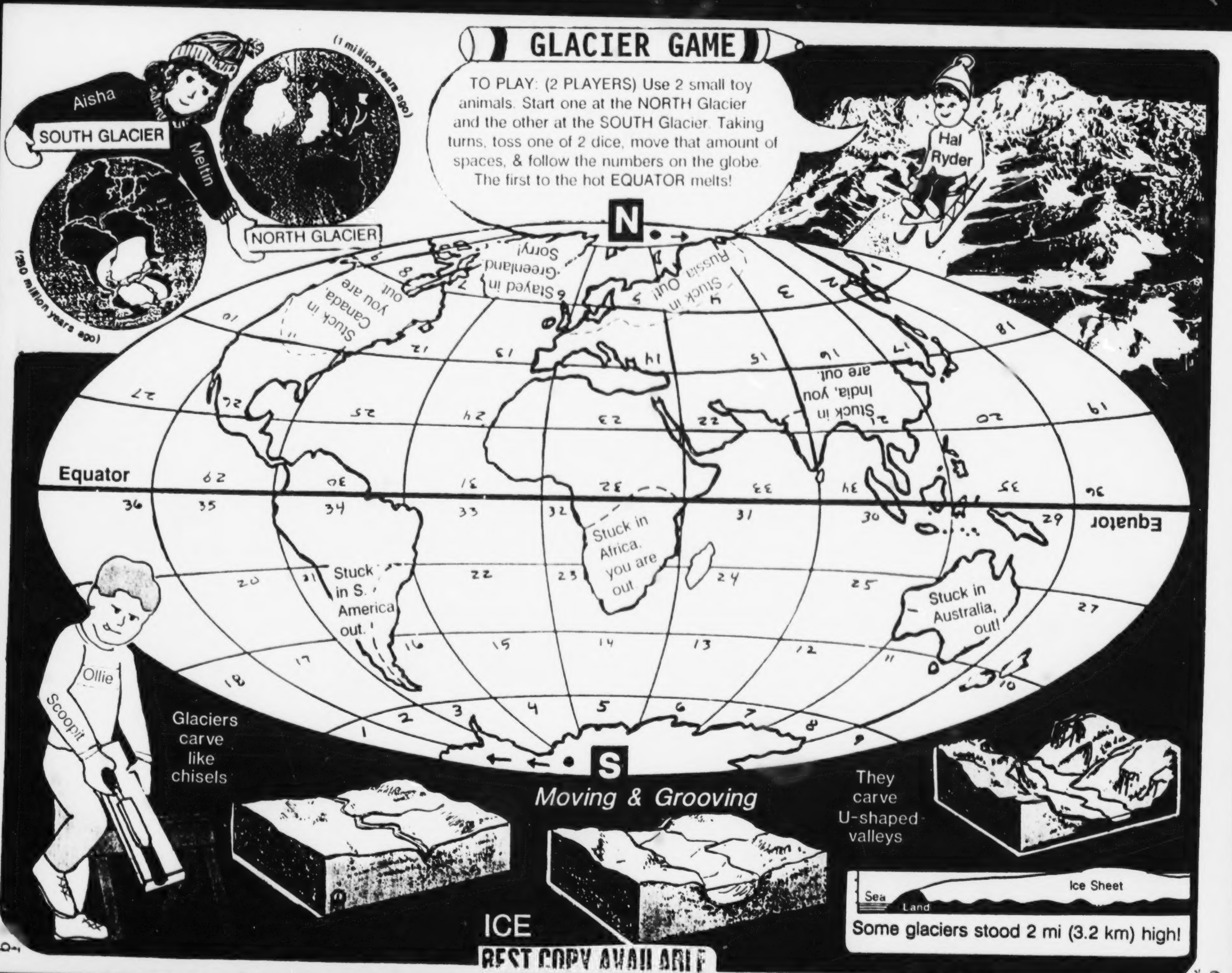
GLACIER GAME

TO PLAY: (2 PLAYERS) Use 2 small toy animals. Start one at the NORTH Glacier and the other at the SOUTH Glacier. Taking turns, toss one of 2 dice, move that amount of spaces, & follow the numbers on the globe. The first to the hot EQUATOR melts!


(1 million years ago)
Aisha
SOUTH GLACIER
Meltin
NORTH GLACIER
(280 million years ago)
Hal Ryder
N
S
Equator
Equator
Stuck in Canada, you are out
Stayed in Greenland Sorry!
Stuck in Russia Out!
Stuck in India, you are out.
Stuck in Africa, you are out
Stuck in S. America out.
Stuck in Australia, out!
Ollie
Scoopit
Glaciers carve like chisels
Moving & Grooving
They carve U-shaped valleys
Sea
Land
Ice Sheet
ICE

Some glaciers stood 2 mi (3.2 km) high!

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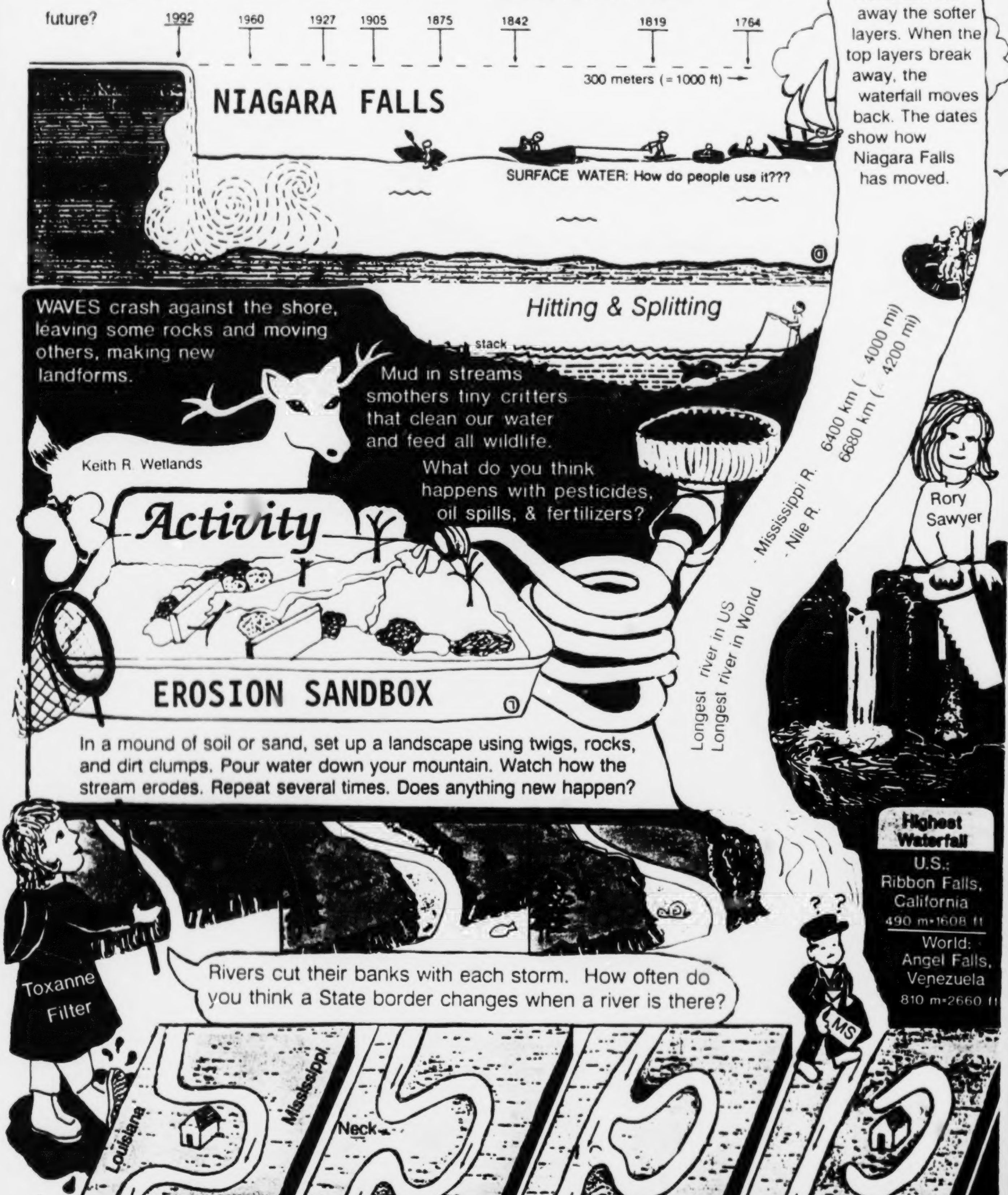
RIVERS: WATER IS POWERFUL


future?
1992
1960
1927
1905
1875
1842
1819
1764
300 meters (= 1000 ft) →
NIAGARA FALLS
SURFACE WATER: How do people use it???
Hitting & Splitting
stack
Keith R. Wetlands
Rory Sawyer
Longest river in US · Mississippi R. 6400 km (= 4000 mi)
Longest river in World · Nile R. 6680 km (= 4200 mi)
Activity
EROSION SANDBOX
Toxanne Filter
MS
Louisiana
Mississippi
Neck
Oxbow Lake

Water can eat away the softer layers. When the top layers break away, the waterfall moves back. The dates show how Niagara Falls has moved.

WAVES crash against the shore, leaving some rocks and moving others, making new landforms.

Mud in streams smothers tiny critters that clean our water and feed all wildlife.

What do you think happens with pesticides, oil spills, & fertilizers?

In a mound of soil or sand, set up a landscape using twigs, rocks, and dirt clumps. Pour water down your mountain. Watch how the stream erodes. Repeat several times. Does anything new happen?

Highest Waterfall

U.S.:
Ribbon Falls,
California
490 m=1608 ft

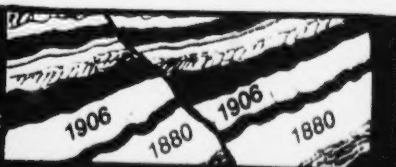
World:
Angel Falls,
Venezuela
810 m=2660 ft

Rivers cut their banks with each storm. How often do you think a State border changes when a river is there?

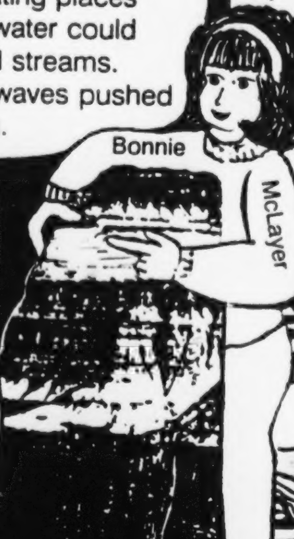
NATURAL LAYERS

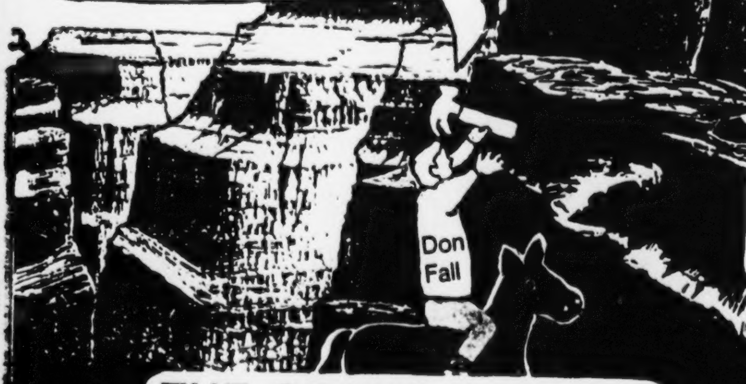
Once Upon A Time, parts of the Earth were covered by oceans. When the weather got colder, glaciers grew at the poles. This action lowered the water level, creating places where rain, snow, and mountain runoff water could fill the spaces forming lakes, rivers, and streams. While heat and ice changed the land, waves pushed and rivers carved new landforms.

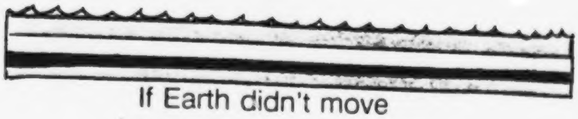
You can see shifted layers at faults


1906
1880
1906
1880

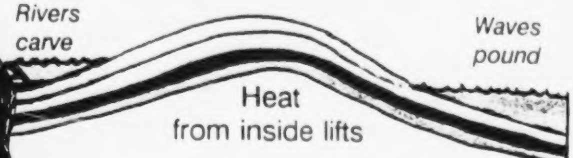
At the Grand Canyon, the mighty Colorado River carved deep grooves in the Earth's crust, leaving us a picture of many layers (STRATA) below. It took the river 30 million years to cut 1800 m (1 mi.!) down for us to see clues of time and climate changes!


Bonnie
McLayer

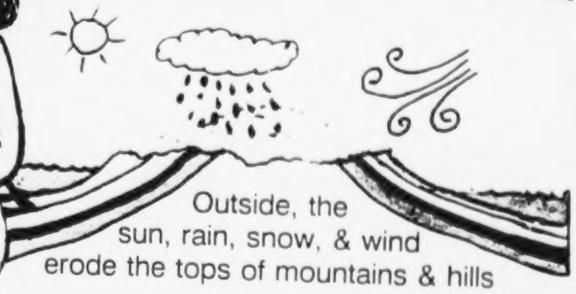




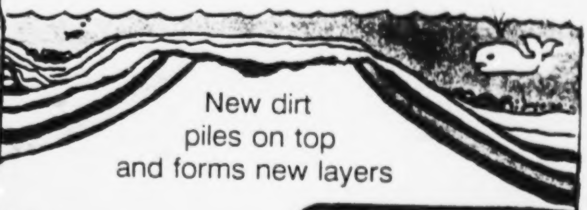
If Earth didn't move layers would be smooth


Rivers carve
Waves pound

Heat from inside lifts



Outside, the sun, rain, snow, & wind erode the tops of mountains & hills

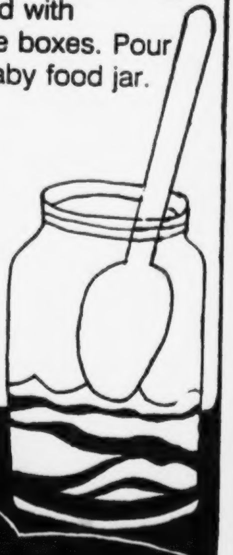


New dirt piles on top and forms new layers

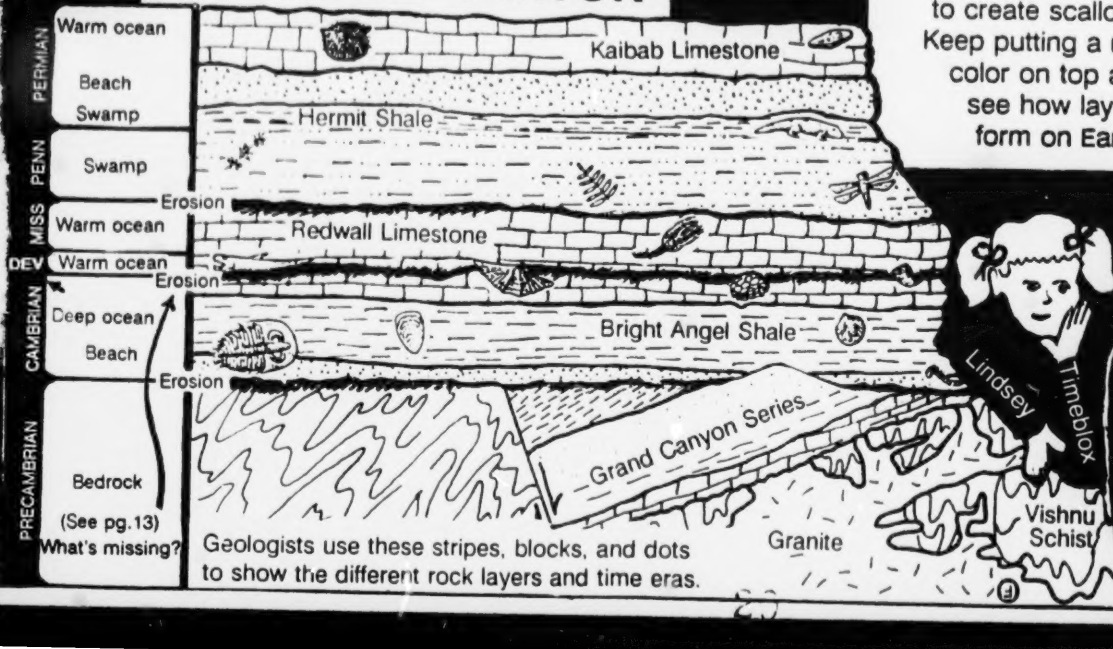
Activity

To make a **LAYERED SAND JAR**, mix sand with powdered tempera paint in shoe boxes. Pour different colored layers into a baby food jar.

Add some layers on an angle or gently press a spoon around the edges to create scallops. Keep putting a new color on top and see how layers form on Earth.



THE GRAND CANYON


PERMIAN
Warm ocean
Beach
Swamp
PENN
Swamp
MISS
Warm ocean
DEV
Warm ocean
CAMBRIAN
Deep ocean
Beach
PRECAMBRIAN
Bedrock
(See pg.13)
What's missing?
Erosion
Erosion
Erosion
Kaibab Limestone
Hermit Shale
Redwall Limestone
Bright Angel Shale
Grand Canyon Series
Granite
Vishnu Schist
Lindsey
Timeblox

Geologists use these stripes, blocks, and dots to show the different rock layers and time eras.

By comparing the colors, the fossils, & the thicknesses of the layers in other parts of the world, we solve the mystery of Earth's history.

AGES & STAGES

COLORING TIME Activity

INTERESTING INFO

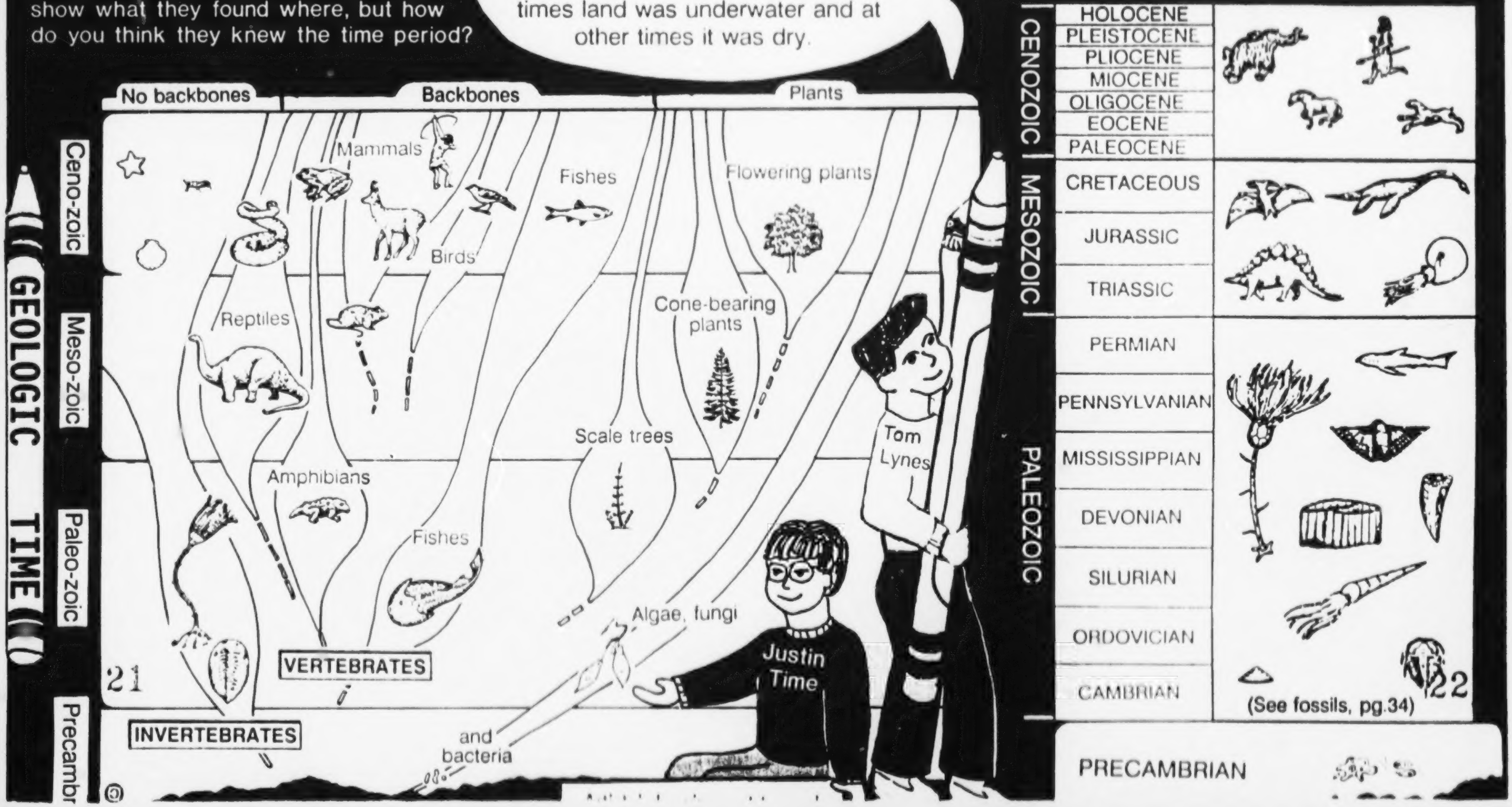
Earth's inner forces (spreading, lifting, folding, faulting, and volcanoes) push up & build layers. The outer forces (glaciers, weather, and erosion) move and destroy layers. Because of this, the top layer could be from any time. Scientists needed a way to date the layers to know what time period they were digging in. They made charts to show what they found where, but how do you think they knew the time period?

Paleontologists from all over find the same kinds of fossils in certain layers. Older layers show single-celled plants. Newer layers show bones of extinct mammals. Our climate changes affected the plants (FLORA) and animals (FAUNA) throughout time. During big changes, new species grew. New names were given to such layers because at times land was underwater and at other times it was dry.

COLOR THE CHARTS on both pages by the time EPOCH or ERA. Can you see how long the Precambrian lasted? Most of these charts don't show all of geologic time.

LEGEND	
[red]	HOLOCENE
[orange]	PLEISTOCENE
[yellow]	CENOZOIC
[green]	MESOZOIC
[blue]	PALEOZOIC
[violet]	PRECAMBRIAN

(See pg.23 to learn how these got named.)


No backbones
Backbones
Plants
GEOLOGIC TIME
Ceno-zoic
Meso-zoic
Paleo-zoic
Precambr
Mammals
Fishes
Flowering plants
Birds
Reptiles
Cone-bearing plants
Scale trees
Amphibians
Fishes
Algae, fungi
and bacteria
VERTEBRATES
INVERTEBRATES
21
Tom Lynes
Justin Time
CENOZOIC
MESOZOIC
PALEOZOIC
HOLOCENE
PLEISTOCENE
PLIOCENE
MIOCENE
OLIGOCENE
EOCENE
PALEOCENE
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
PENNSYLVANIAN
MISSISSIPPIAN
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
22
PRECAMBRIAN

(See fossils, pg.34)

©

MEASURING TIME

Earth's time is measured in MILLIONS of years. To show how long the periods of time are, artists have to draw time in chunks. We (HOLOCENE) are only a small speck on these charts. Color NOW red on all of these.

WHAT IS A MILLION?

Picture the back of a rug.

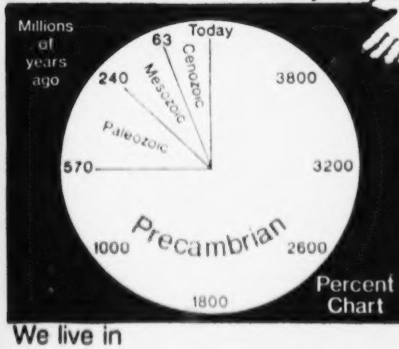
1 square inch ↶ This year!

s q u a r e inch is 100 holes

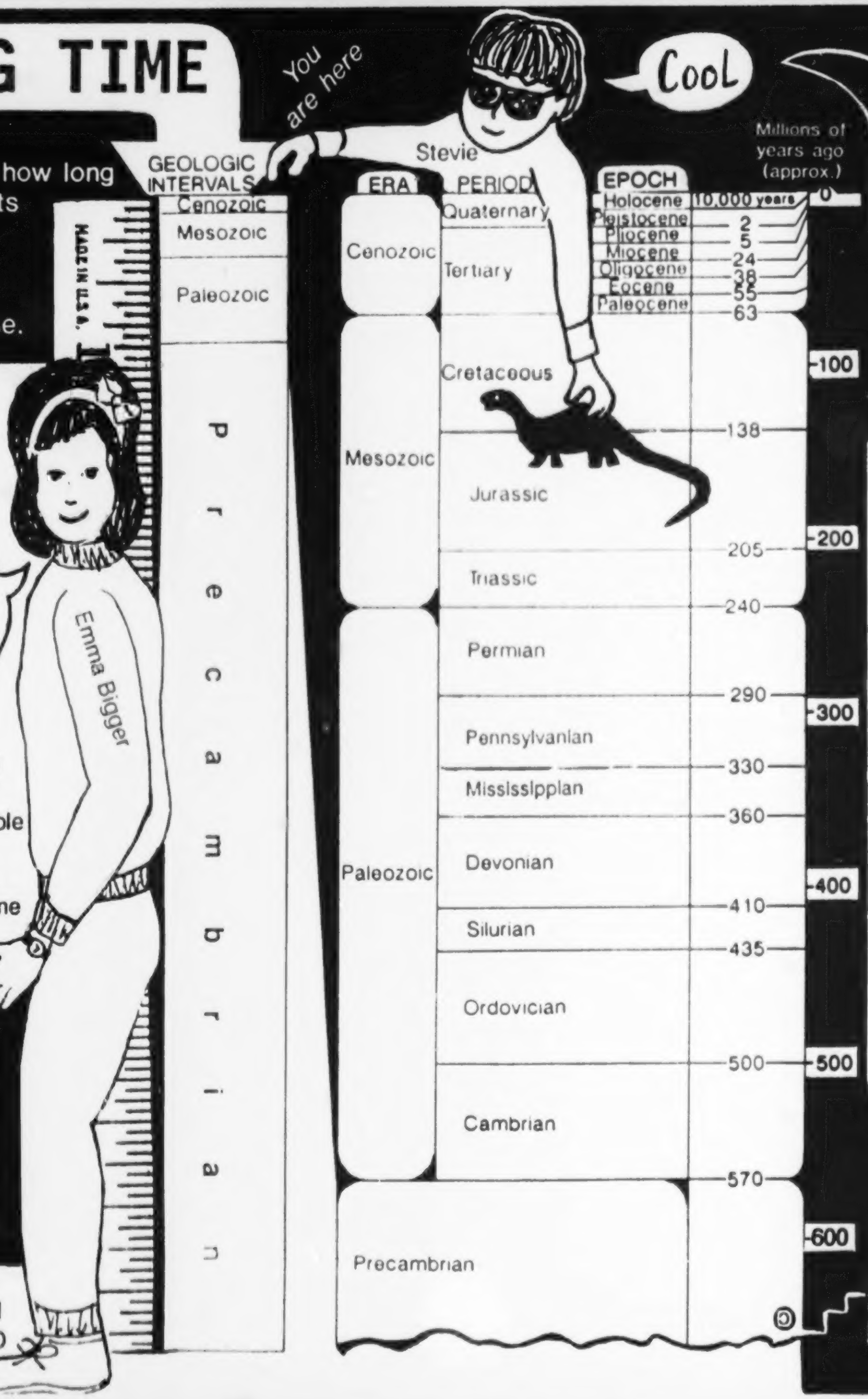
Count back. How many years have you been an Earthling?

FASCINATING FACT

In a 9' x 12' rug, there are 1,500,000 (1½ million) holes. Our HOLOCENE epoch is 10,000 years old. If each hole shows 1 year, we need a 10" x 10" square to show today. It would take 46,000 rugs to show all of Earth's time of four and a half billion years!



We live in
the ______________ EPOCH
the ______________ PERIOD
& the 25 ______________ ERA!


You are here
Stevie
Cool
GEOLOGIC INTERVALS
Cenozoic
Mesozoic
Paleozoic
Precambrian
MADE IN U.S.A.
Emma Bigger
ERA
PERIOD
EPOCH
Millions of years ago (approx.)
Cenozoic
Mesozoic
Paleozoic
Precambrian
Quaternary
Tertiary
Cretaceous
Jurassic
Triassic
Permian
Pennsylvanian
Mississippian
Devonian
Silurian
Ordovician
Cambrian
Holocene
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
Paleocene
10,000 years
0
2
5
24
38
55
63
100
138
200
205
240
290
300
330
360
400
410
435
500
570
600

INTERESTING INFO.
If you found a dinosaur bone in your backyard, you would know your house was built on a Mesozoic layer. If you went uphill or to lower ground, you might be digging in another time period. When dinosaurs roamed, the earth was hotter. No one knows why they became extinct.

What is your theory? ?

GAME

FABULOUS FINDS

Because the Earth changes, weird* things have been found in strange places.

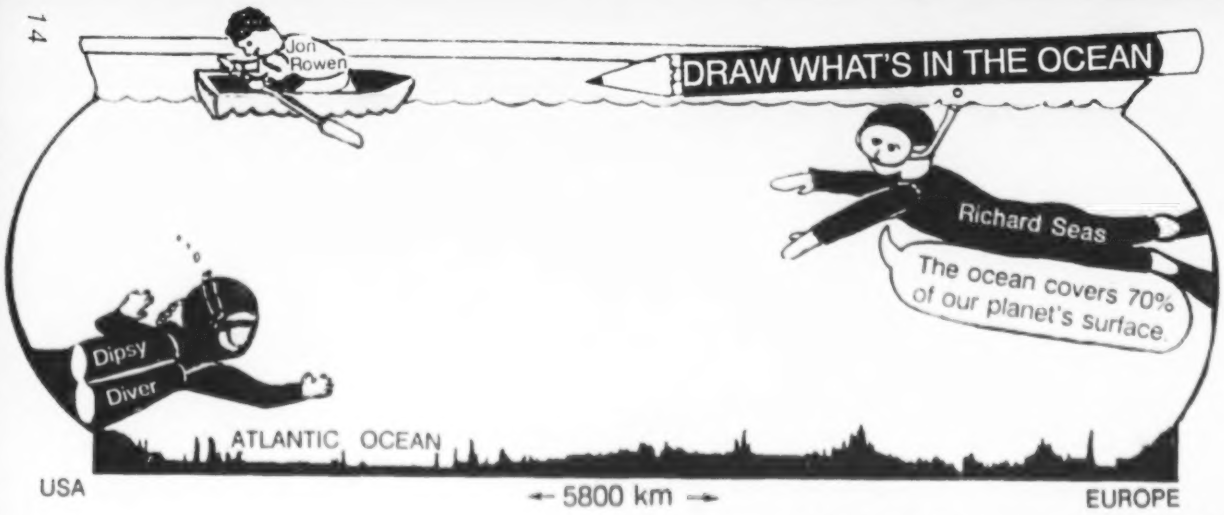
WHAT WOULD YOU THINK IF YOU FOUND:

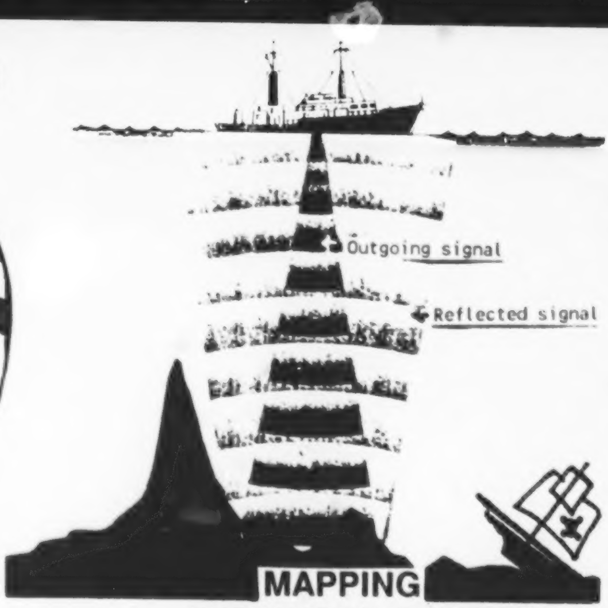
Whale fossils in a fresh water lake?
Palm tree fossils under Arctic ice? ?
Salt water fish fossils in creeks?
Glacier snow over volcanic lava?
Volcanic lava under a city?
Sea shell fragments in mountains & deserts?
Evergreen tree remains in tropical jungles?
Small hot-blooded animal bones under a glacier?
Dried up river cobbles under desert land?
Fossil trees under lakes?
Coral fossils in the Alps?

Sieta Fossils

Activity

On another piece of paper **DESIGN** your own time chart.


DRAW WHAT'S IN THE OCEAN
Jon Rowen
Richard Seas
The ocean covers 70% of our planet's surface.
Dipsy Diver
ATLANTIC OCEAN
USA
← 5800 km →
EUROPE

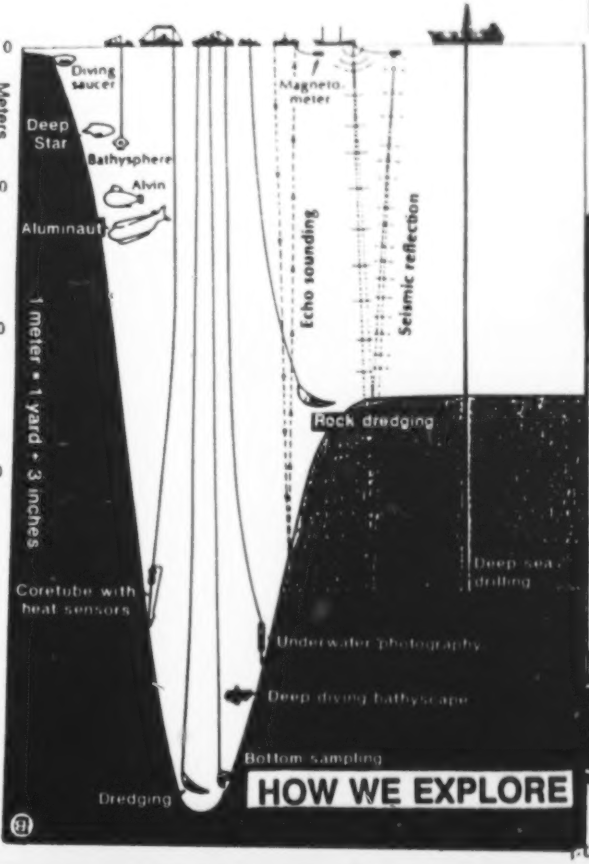

Outgoing signal
Reflected signal

THE OCEAN FLOOR

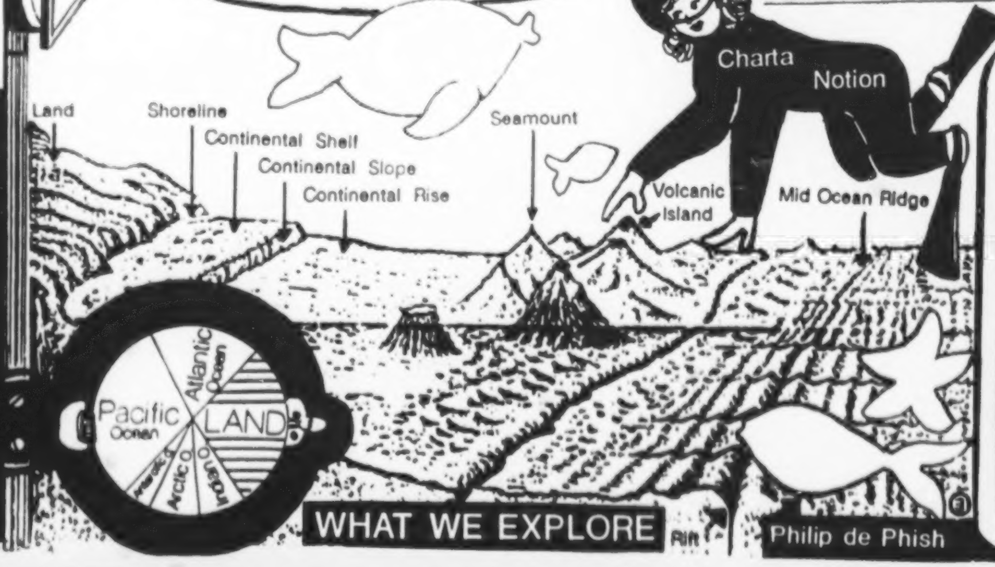
MAPPING THE WATER PLANET

WHY WE EXPLORE

The ocean floor is the largest place still to be explored on Earth. It is very different from the land above water. It also is the thinnest part of the crust.


0
Meters
2000
4000
6000
8000
10,000
11,000
Diving saucer
Deep Star
Bathysphere
Alvin
Aluminaut
1 meter = 1 yard + 3 inches
Magnetometer
Echo sounding
Seismic reflection
Rock dredging
Deep sea drilling
Coretube with heat sensors
Underwater photography
Deep diving bathyscape
Bottom sampling
Dredging

HOW WE EXPLORE


Land
Shoreline
Continental Shelf
Continental Slope
Continental Rise
Seamount
Volcanic Island
Mid Ocean Ridge
Charta Notion
Pacific Ocean
Atlantic Ocean
LAND
Arctic
Indian
Rift
Philip de Phish

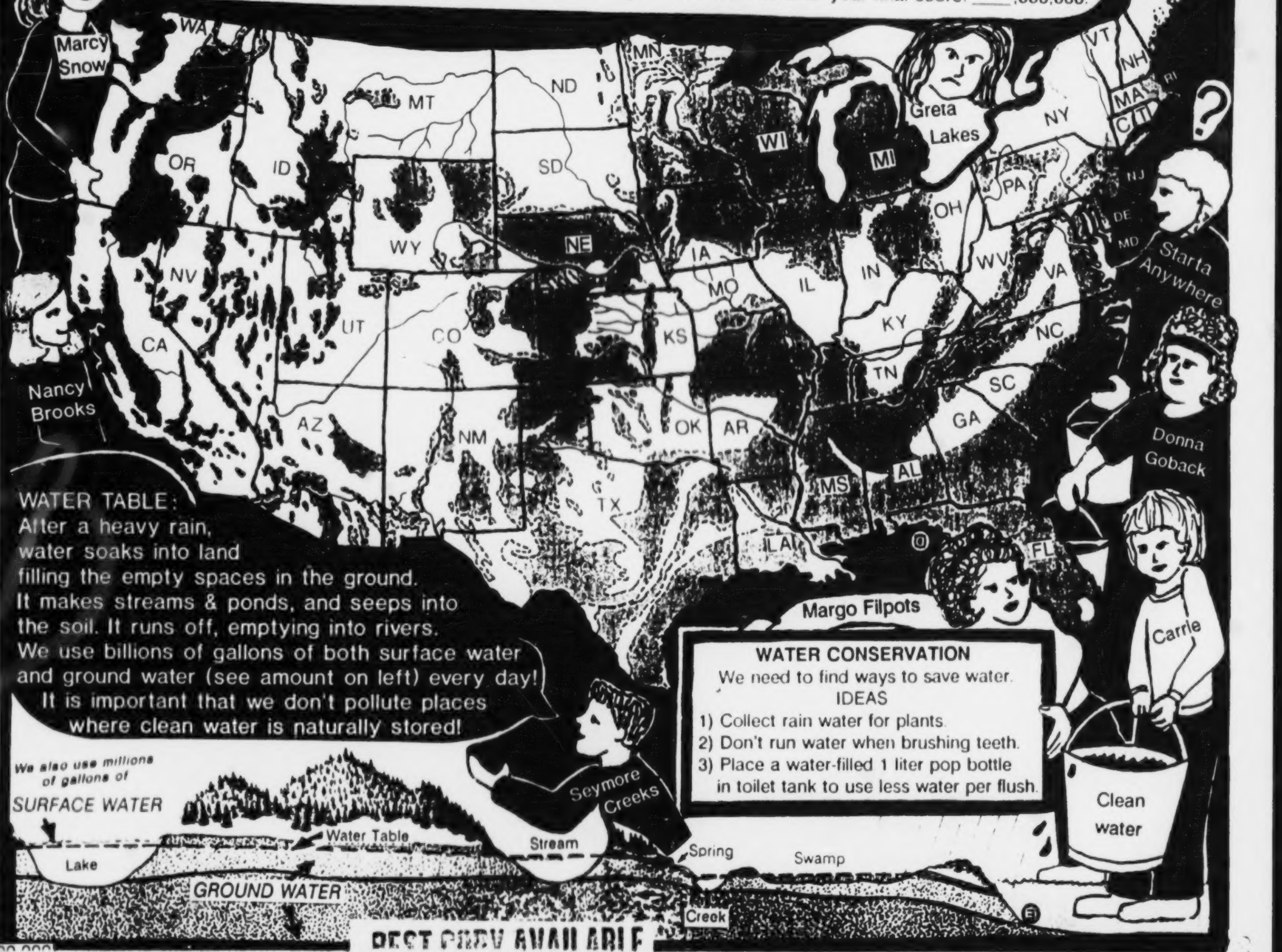
WHAT WE EXPLORE

SONAR: Scientists record the time it takes sound waves to get to the bottom and bounce back. They figure the depth by taking half the time and knowing the speed of sound in water.

GROUND WATER GAME

DAILY USE * (in millions of gallons)	
Alabama	290
Alaska	49
Arizona	4,200
Arkansas	4,300
California	14,600
Colorado	2,800
Connecticut	150
Delaware	82
D.C.	1
Florida	3,800
Georgia	1,200
Hawaii	710
Idaho	6,300
Illinois	980
Indiana	1,100
Iowa	900
Kansas	5,600
Kentucky	180
Louisiana	1,800
Maine	80
Maryland	174
Massachusetts	320
Michigan	530
Minnesota	670
Mississippi	1,500
Missouri	470
Montana	200
Nebraska	7,100
Nevada	710
New Hampshire	65
New Jersey	730
New Mexico	1,800
New York	970
North Carolina	770
North Dakota	110
Ohio	740
Oklahoma	960
Oregon	1,100
Pennsylvania	1,000
Rhode Island	37
South Carolina	210
South Dakota	330
Tennessee	460
Texas	9,700
Utah	770
Vermont	45
Virginia	370
Washington	750
West Virginia	220
Wisconsin	580
Wyoming	+ 540
	000,000

The darker places on this map show where there's lots of ground water. The left column shows the millions of gallons used each day!!! TO PLAY: Use an animal marker for each player; throw 1 of 2 dice; travel to bordering states; collect ground water for 10 turns each & add up the score! *Remember, these numbers are in **MILLIONS OF GALLONS** each day, so add **6 zeros** after your final score: ____,000,000.


WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MI
IN
OH
KY
TN
MS
AL
GA
FL
SC
NC
VA
WV
PA
NY
VT
NH
ME
MA
RI
CT
NJ
DE
MD
Marcy Snow
Nancy Brooks
Greta Lakes
Starta Anywhere
Donna Goback
Margo Filpots
Carrie
Clean water
Seymore Creeks
We also use millions of gallons of
SURFACE WATER
Water Table
Lake
Stream
Spring
Swamp
GROUND WATER
Creek

WATER TABLE:
After a heavy rain, water soaks into land filling the empty spaces in the ground. It makes streams & ponds, and seeps into the soil. It runs off, emptying into rivers. We use billions of gallons of both surface water and ground water (see amount on left) every day! It is important that we don't pollute places where clean water is naturally stored!

WATER CONSERVATION

We need to find ways to save water.

IDEAS

1) Collect rain water for plants.
2) Don't run water when brushing teeth.
3) Place a water-filled 1 liter pop bottle in toilet tank to use less water per flush.

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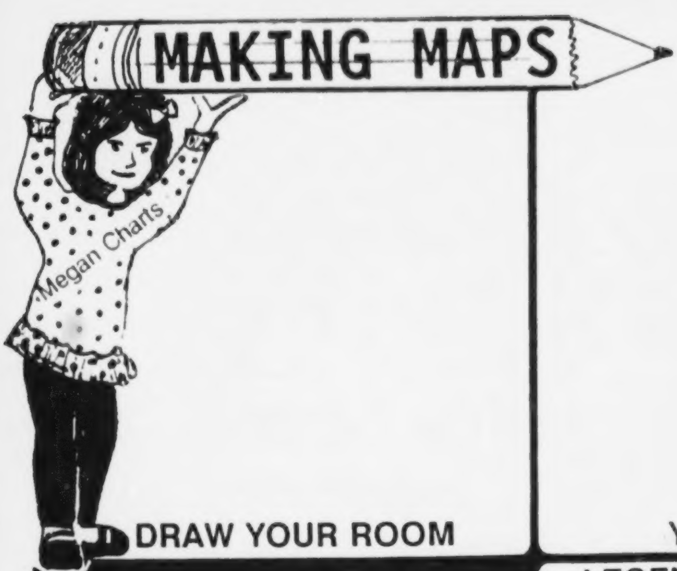
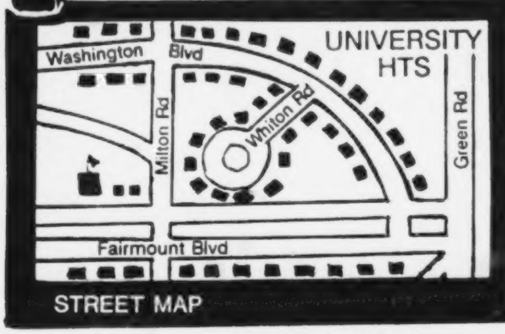
MAKING MAPS


Megan Charts

DRAW YOUR ROOM

YOUR HOUSE

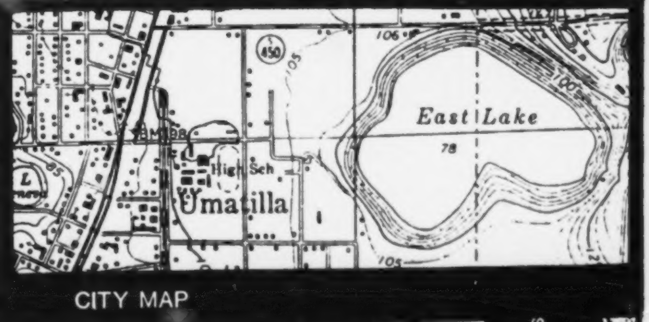
YOUR STREET


Washington Blvd
UNIVERSITY HTS
Milton Rd
Whiton Rd
Green Rd
Fairmount Blvd

STREET MAP

LEGEND

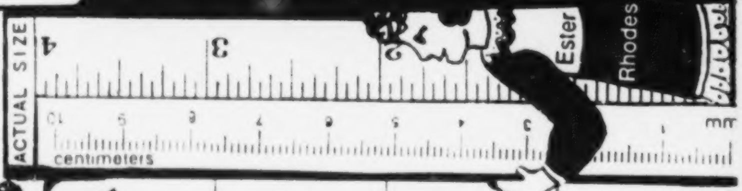
- • house
- ▬ apartment
- ■ school
- house of worship
- lake
- RR tracks
- road
- highway


450
105
106
100
East Lake
78
High Sch
Umatilla
105

CITY MAP

HOW TO MAP

Before airplanes & photography, people had to measure the land by foot. To make a picture of what they saw, they drew LANDMARKS and counted the footsteps between each place. Once they knew how far it was, they made CHARTS. These were just words or lines showing the DIRECTIONS. To make a map, decide how much land you will measure and how much space you will need to show it (SCALE). GRID LINES help to place landmarks.


ACTUAL SIZE
4
3
2
centimeters
mm
Ester
Rhodes

Activity

DRAW YOUR CITY

HOW TO START: Decide which landmarks you will use. Locate your house, your school, & a main street. To make a LEGEND, make a column with a symbol for each place. Are there railroad tracks, an airport, a park? How will you show hills? Holes? Flat places? Colors can be used to show the changing height of the ground (ELEVATION).

BE A BIRD: Draw Aerial View

LEGEND

SCALE

METRIC

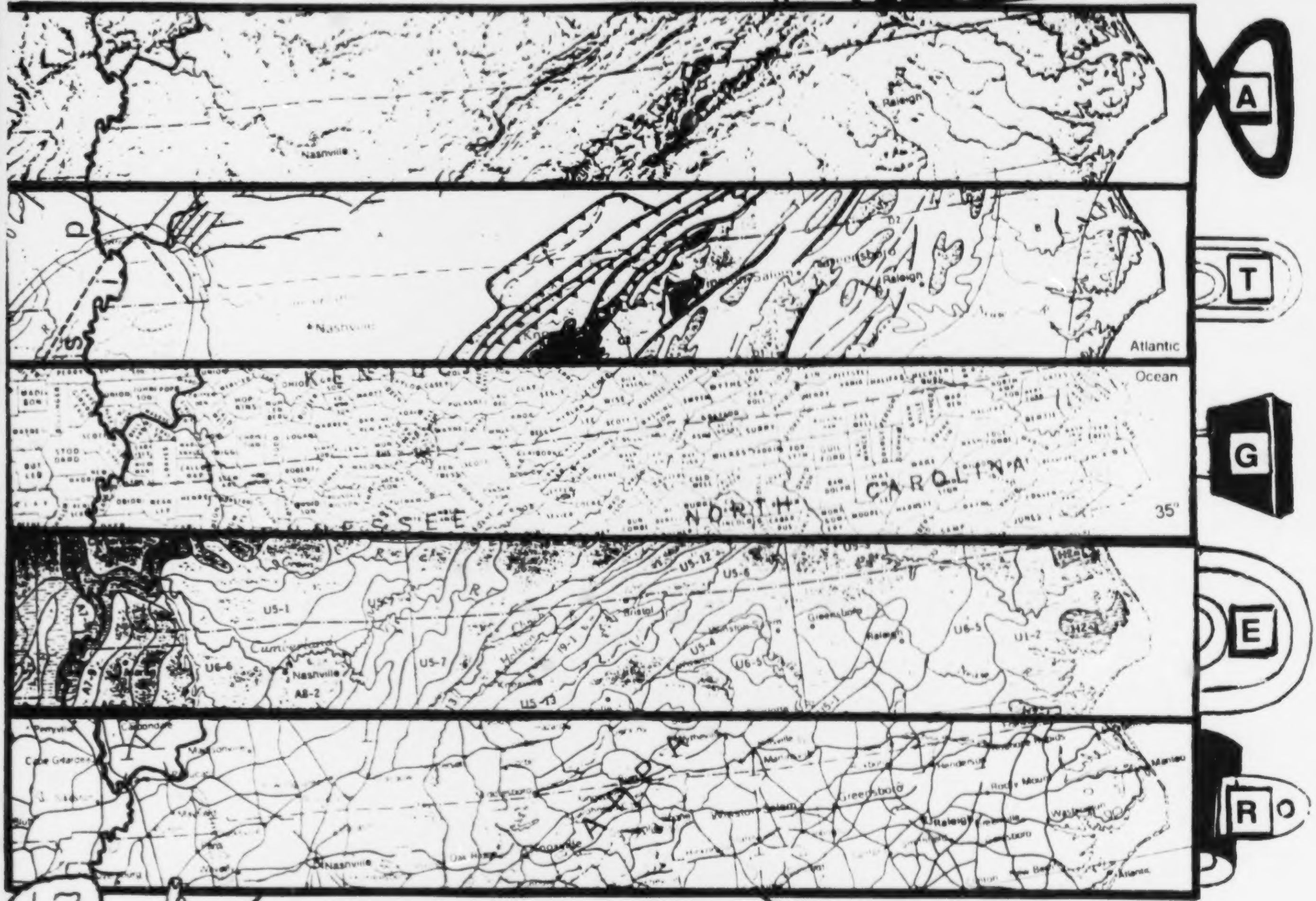
1 cm= ? km

ENGLISH

1 inch= ? mi

SAME PLACE - DIFFERENT MAPS

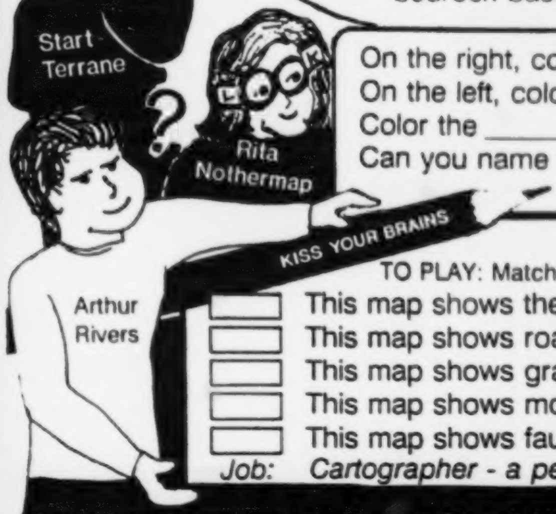
(Areal View) **Scale** 1 inch = 120 mi., 1 cm = 80 km.


Nashville
Raleigh
A
Nashville
Raleigh
Atlantic
Ocean
T
KENTUCKY
NORTH CAROLINA
TENNESSEE
35°
G
Nashville
Raleigh
E
Nashville
Raleigh
R

Start Terrane

If your city wanted to build a skyscraper, city officials might want to check with a geologist to find out where a solid bedrock base might be.

Scientists make different SURVEYS to get these kinds of information. Above are different maps of the same place from ground surveys.


Rita Nothermap
Arthur Rivers
KISS YOUR BRAINS

Activity

On the right, color the row of islands on the ________________ Ocean.
On the left, color the ________________ River.
Color the ___________________ Mountains down the center.
Can you name the states on the maps?

Check maps on pgs. 15 & 21.

GAME

Which is Which ?

TO PLAY: Match the following with the maps above

- ☐ This map shows the COUNTIES in each state.
- ☐ This map shows roads. It is a HIGHWAY map.
- ☐ This map shows gravel and swamps. It is a SOILS map.
- ☐ This map shows mountains and valleys. It is a RELIEF map.
- ☐ This map shows faults & where to look for oil. It is a GEOLOGIC map.

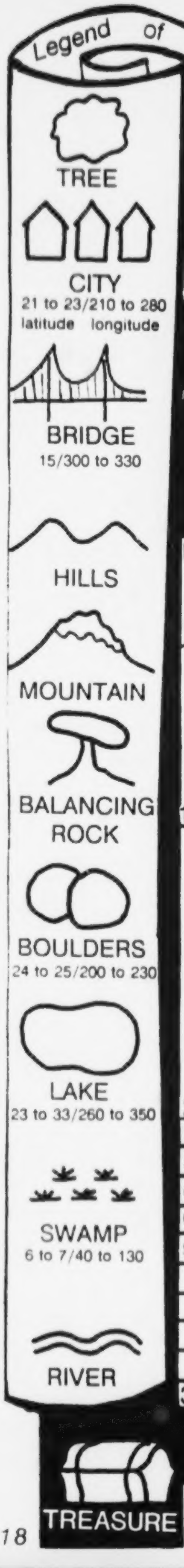
30

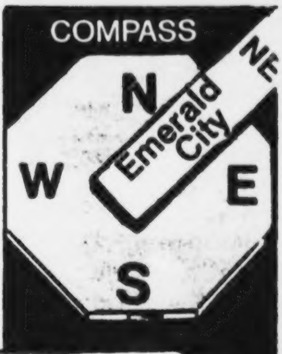
Job: *Cartographer - a person who makes maps.*

Could you draw a map of your State? What would you use for symbols to show different things? Do you know what natural resources are in your State? Find out and show these on your map!

the TREASURE HUNT GAME

One starless night on the way to Silvery Bay, 7 pirates sailed the 7 seas **SE** towards the mouth of the Shawnasee River. They slipped their ship behind the swamp. While their 7 sweethearts slept in the city, they swam along the shore to the suspension bridge. From there, they sneaked 17 paces **W** and spied the balancing rock due **S**. They stepped 7 paces to this spectacular site and switched **SE** for 7 more paces to bury their booty. Were they smart, stupid, or sneaky sailors for selecting this site? Why?


Legend of
TREE
CITY
21 to 23/210 to 280
latitude longitude
BRIDGE
15/300 to 330
HILLS
MOUNTAIN
BALANCING ROCK
BOULDERS
24 to 25/200 to 230
LAKE
23 to 33/260 to 350
SWAMP
6 to 7/40 to 130
RIVER
TREASURE

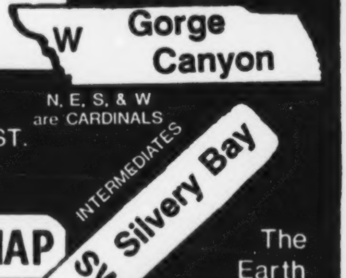

COMPASS
N
NE
Emerald City
W
E
S

Longitude

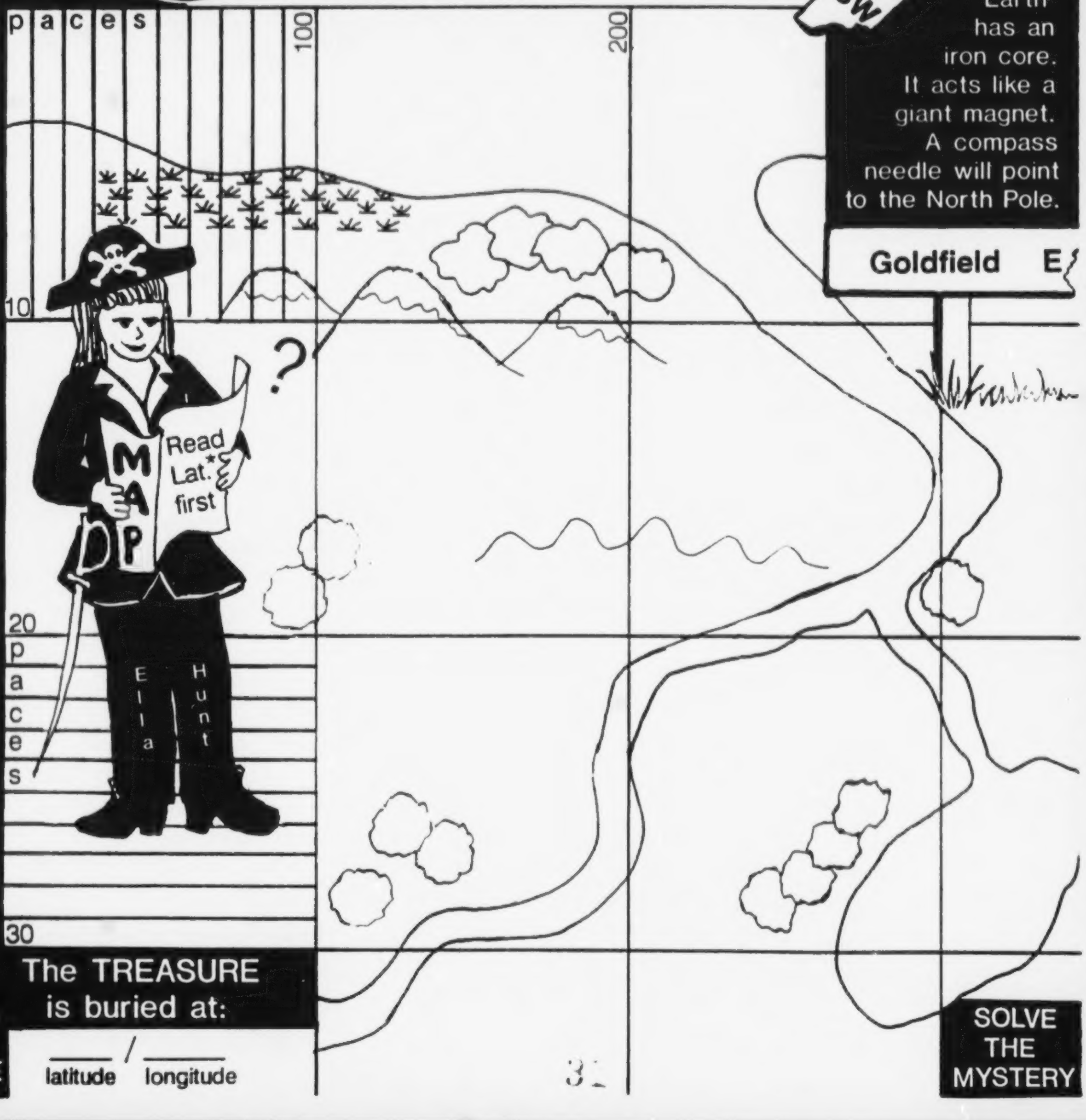
Latitude*

Hints:

Fill in known facts from legend on map FIRST.
Remember they suspected their ship would be searched when sailing into the city!


W Gorge Canyon
N, E, S, & W are CARDINALS
INTERMEDIATES
SW Silvery Bay

LOOKING DOWN - GRID MAP


p a c e s
100
200
10
20
p
a
c
e
s
30
?
MAP
Read Lat.* first
Ella
Hunt
Goldfield E

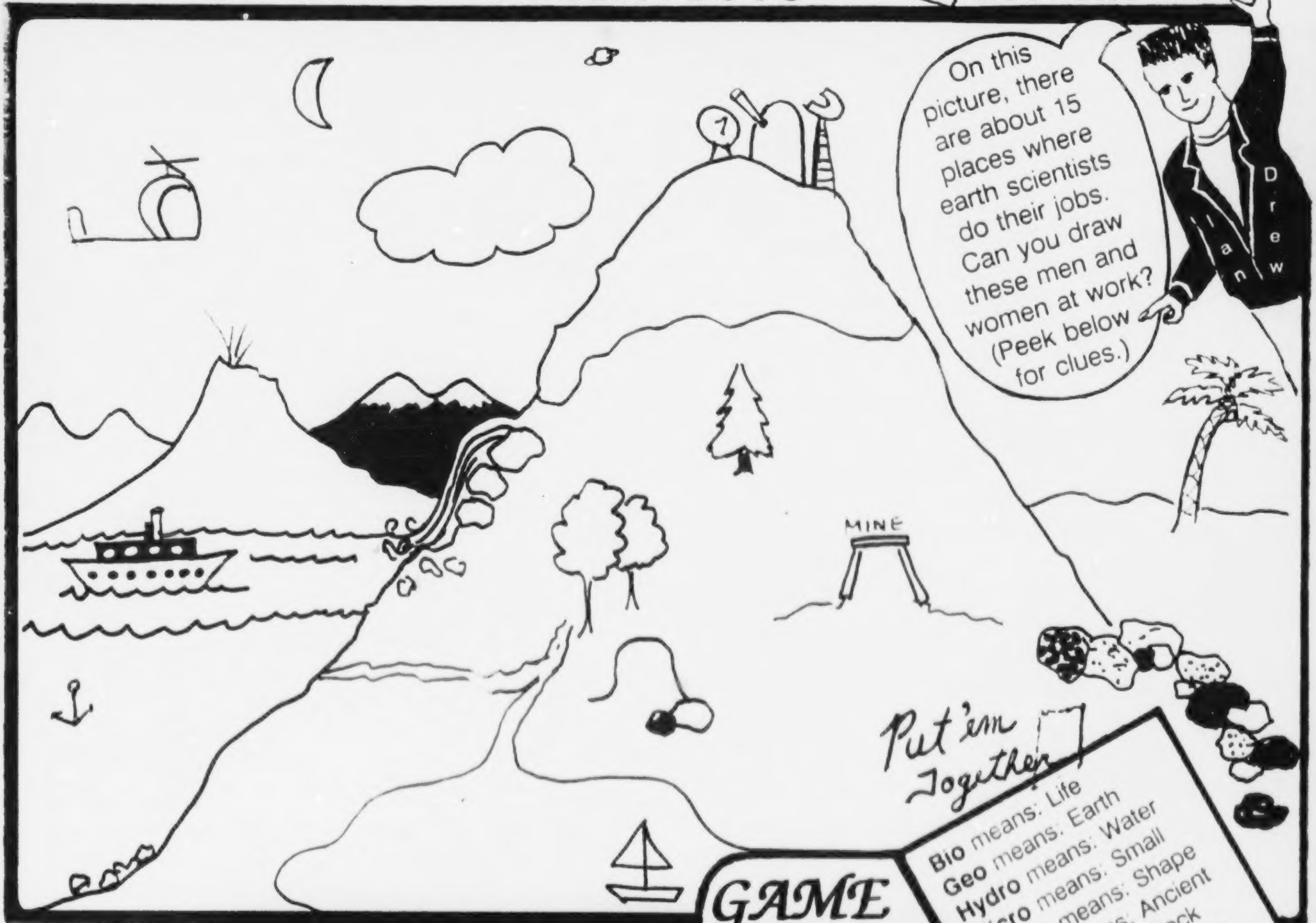
The Earth has an iron core. It acts like a giant magnet. A compass needle will point to the North Pole.

The TREASURE is buried at:

_____ / _____
latitude longitude

SOLVE THE MYSTERY

DRAW THE EARTH SCIENTISTS


On this picture, there are about 15 places where earth scientists do their jobs. Can you draw these men and women at work? (Peek below for clues.)
Drew
Ian
MINE

GAME

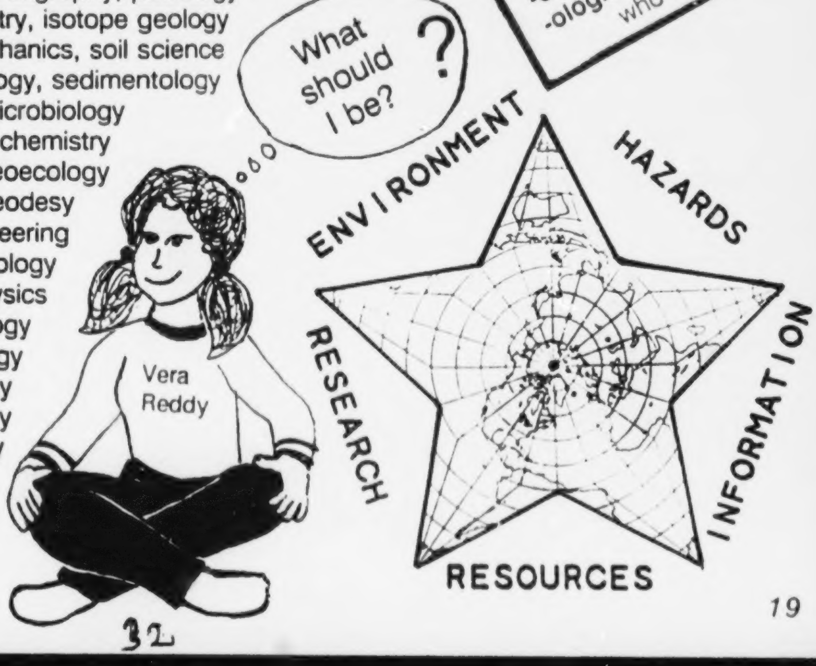
Put'em Together

Bio means: Life
Geo means: Earth
Hydro means: Water
Micro means: Small
Morph means: Shape
Paleo means: Ancient
Petro means: Rock
Physi means: Nature
-ology means: Study
-ologist means: Person who studies

EARTH SCIENCE NAMES

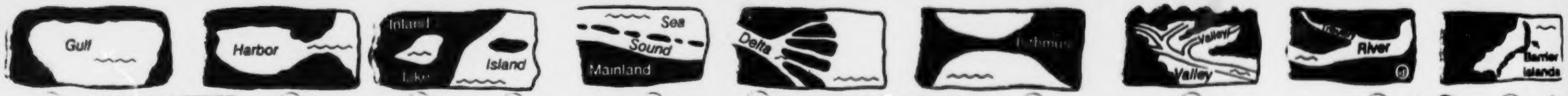
JOB$ WITH:

ROCKS	mapping, bedrock geology, stratigraphy, petrology
CHEMISTRY	geochemistry, organic chemistry, isotope geology
SOILS	engineering geology, soil mechanics, soil science
LAND	surficial geology, geomorphology, sedimentology
LIVING THINGS	biogeology, geobotany, geomicrobiology
FRESH WATER	hydrology, hydrogeology, geochemistry
FOSSILS	paleontology, palynology, paleoecology
DEEP EARTH	geophysics, geomagnetics, geodesy
EARTHQUAKES	seismology, earthquake engineering
METALS	economic geology, mining geology
MOUNTAINS	structural geology, tectonophysics
FUELS	petroleum geology, coal geology
PLANETS	astrogeology, planetary geology
VOLCANOES	volcanology, igneous petrology
THE OCEAN	marine geology, oceanography
SATELLITES	remote sensing, photogeology
MINERALS	mineralogy, crystallography
MONEY	mineral economics
BOOKS	geological editing
CHILDREN	science teacher
GLACIERS	glaciology


What should I be?
Vera Reddy
ENVIRONMENT
HAZARDS
RESEARCH
INFORMATION
RESOURCES

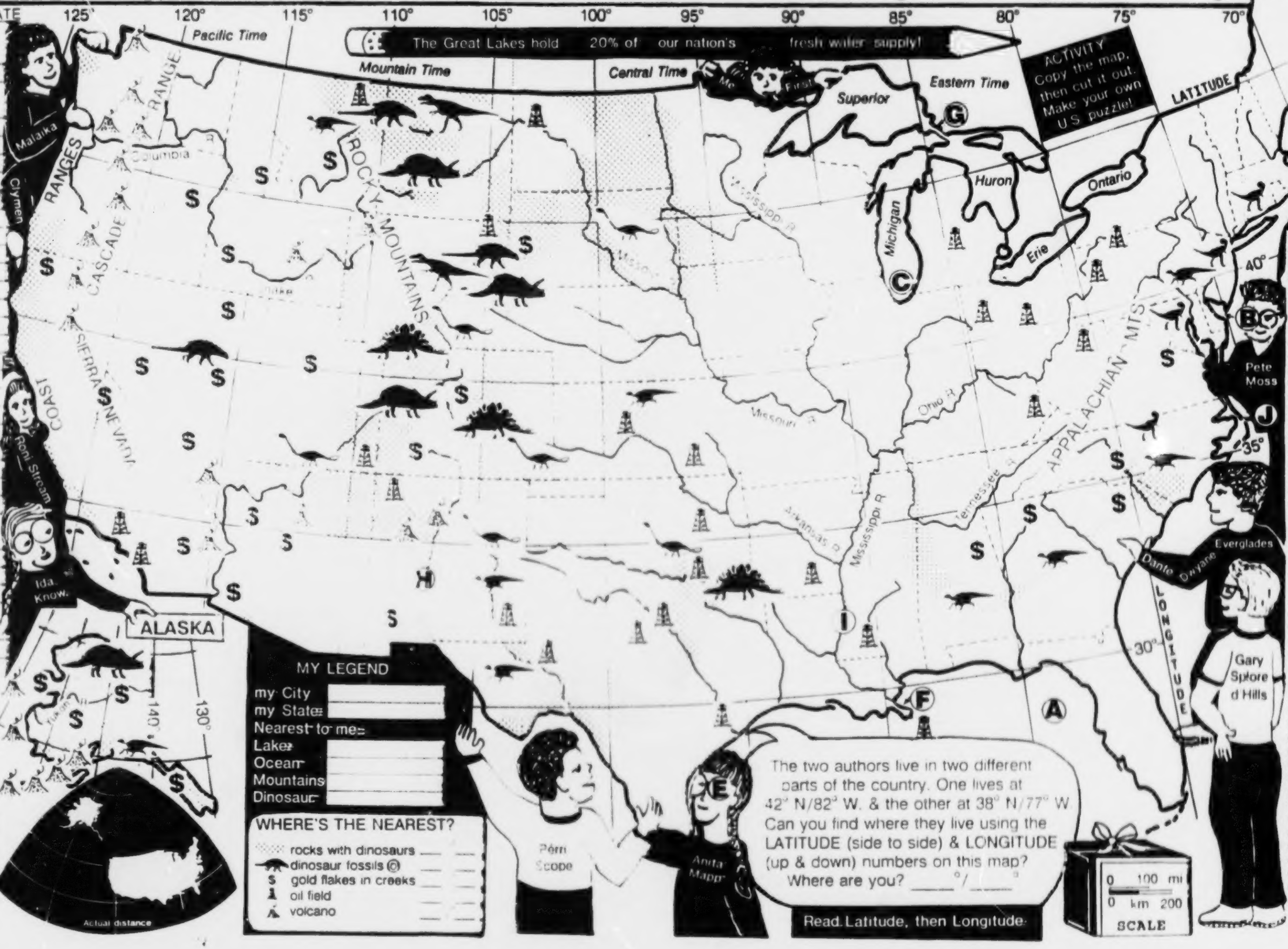
WATERFORMS GAME →

EXPLORERS GAME


Gulf
Harbor
Inland Lake
Island
Sea
Sound
Mainland
Delta
Isthmus
Valley
Valley
River
Barrier Islands

○ FIND MY LETTER ○ ○ ○ ○ COLOR THE MAP ○ ○ ○ ○

Park/Place	lat°N/long°W	STATE
Mauna Loa Volcano	19°/155°	
Mt. McKinley	62°/150°	
Arctic National Wildlife Refuge	70°/142°	
Tongass Forest	58°/132°	
Mt. Rainier	48°/122°	
Mt. St. Helens	46°/122°	
Crater Lake	43°/122°	
Lassen Volcano	41°/121°	
Yosemite Park	38°/120°	
Sequoia Forest	36°/119°	
Glacier Park	49°/114°	
Zion Park	37°/113°	
Bryce Canyon	38°/112°	
Grand Canyon	36°/112°	
Yellowstone Park	45°/111°	
Grand Teton Park	44°/111°	
Dinosaur Park	40°/109°	
Mesa Verde Park	37°/108°	
Rocky Mts. Park	40°/106°	
White Sands Mon.	33°/106°	
Black Hills	44°/104°	
Wind Cave	43°/104°	
Carlsbad Caverns	32°/104°	
Hot Springs	35°/94°	
Mammoth Cave	37°/86°	
Great Smoky Mts.	36°/84°	
Crystal Cave	42°/83°	
Indian Mounds	39°/82°	
Everglades Swamp	25°/81°	
Luray Caverns	39°/79°	
Shenandoah Forest	39°/79°	
Penn Cave	41°/78°	
Plymouth Rock	42°/71°	


125°
120°
115°
110°
105°
100°
95°
90°
85°
80°
75°
70°
Pacific Time
Mountain Time
Central Time
Eastern Time
The Great Lakes hold 20% of our nation's fresh water supply!
Malaika
Clymen
Roni Stream
Ida Know
RANGES
RANGE
CASCADE
COAST
SIERRA NEVADA
ROCKY MOUNTAINS
Columbia
Superior
Michigan
Huron
Ontario
Erie
Mississippi R.
Missouri R.
Ohio R.
Arkansas R.
Tennessee R.
Mississippi R.
APPALACHIAN MTS.
LATITUDE
LONGITUDE
45°
40°
35°
30°
North
Kenya Find
Pete Moss
Everglades
Dante Dwyane
Gary Splore d Hills
Perri Scope
Anita Mapp
ALASKA
60°
170°W
140°
130°
Actual distance
A
B
C
E
F
G
H
I
J
0 100 mi
0 km 200
SCALE

ACTIVITY
Copy the map, then cut it out. Make your own U.S. puzzle!

MY LEGEND

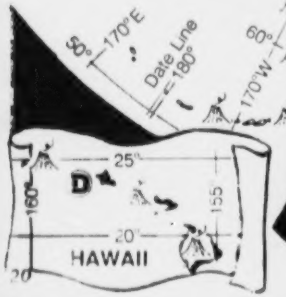
my City ____
my State ____
Nearest to me:
Lake ____
Ocean ____
Mountains ____
Dinosaur ____

WHERE'S THE NEAREST?

▨	rocks with dinosaurs	___	___
	dinosaur fossils ©	___	___
$	gold flakes in creeks	___	___
	oil field	___	___
	volcano	___	___

The two authors live in two different parts of the country. One lives at 42° N/82° W. & the other at 38° N/77° W. Can you find where they live using the LATITUDE (side to side) & LONGITUDE (up & down) numbers on this map? Where are you? ____°/____°

Read Latitude, then Longitude.


50°
170°E
Date Line 180°
25°
D
160
155
20°
HAWAII
20

Alabama	AL
Alaska	AK
Arizona	AZ
Arkansas	AR
California	CA
Colorado	C
Connecticut	C
Delaware	D
D.C.	D
Florida	FL
Georgia	G
Hawaii	HI
Idaho	ID
Illinois	IL
Indiana	IN
Iowa	IA
Kansas	K
Kentucky	KY
Louisiana	LA
Maine	M
Maryland	M
Massachusetts	M
Michigan	M
Minnesota	M
Mississippi	M
Missouri	M
Montana	M
Nebraska	N
Nevada	N
New Hampshire	N
New Jersey	N
New Mexico	N
New York	N
North Carolina	N
North Dakota	N
Ohio	O
Oklahoma	O
Oregon	O
Pennsylvania	P
Rhode Island	R
South Carolina	S
South Dakota	S
Tennessee	T
Texas	T
Utah	U
Vermont	V
Virginia	V
Washington	W
West Virginia	W
Wisconsin	W
Wyoming	W
	2

33

34

FASCINATING FINDS

The volcano Krakatoa spewed out so many floating PUMICE rocks that ships saw them all over the Indian Ocean in 1883.

Volcanoes •

A volcano in Yellowstone Park erupted and buried a whole forest in Wyoming. When it was exposed by weathering, the PETRIFIED TREES were found standing in place. At Mt. Saint Helens, trees fell like toothpicks away from the volcanic BLAST.

In a museum in Martinique, they display things changed by the heat of VOLCANIC GAS during the 1902 eruption of the volcano Pelee. Thread, bread, and coffee beans turned into carbon. A bell and bottles were actually deformed. Scissors and nails were fused & nothing happened to the marble statues. Why? (Peek on pg. 8)

Maps •

A map from 1513 shows two islands in Antarctica where there is now ice. In 1957, people who study the deep Earth used SOUND WAVES and showed that two islands really were there.

Two children in Maine discovered TOURMALINE in the roots of a tree that had fallen during a storm. Watermelon-color slices of this gem are used in jewelry.

• Gems

In Columbia, a Spanish horseman saw that his horse was limping. When he stopped to look at its hoof, he found an EMERALD - the first discovered in this South American country.

Madge N. Dat
START
Tommy Story

Diamonds •

In South Africa, a boy discovered a DIAMOND that weighed 83 carats. This led to the diamond rush of 1869!

While playing golf in West Virginia, a boy & his dad found the 34-carat Punch Jones diamond.

One would think that diamonds are so hard that they cannot be destroyed. But they are so brittle that they can be smashed.

When 12, Mary Anning found the first reptile SKELETON in England & started her own fossil business.

At a dinosaur birthday party dig in Maryland in 1989, a child found a real dinosaur bone!

Even poop gets turned into rock. Scientists study fossilized FECAL PELLETS to discover what dinosaurs & other animals ate. Microscopic pellets even form oil (PETROLEUM).

Dinosaurs •

HOW THINGS GET THEIR NAMES

Why not call me Todd or Brian, Ayana or Melanie?
C.D. Tales

ROCKS

(for size, place, or property)

GRANITE = grain (Latin)
SANDSTONE = sand (Ger.)
SCHIST = split (Greek)
LIMESTONE = smear (Lat.)

MINERALS

(for people, places, or composition)

ADAMITE = Mr. Adam
CHILDRENITE = Mr. Children
ZUNYITE = Zuni Mine, Colo.
GALENA = lead (Latin)

DINOSAURS

(Latin words for characteristics)

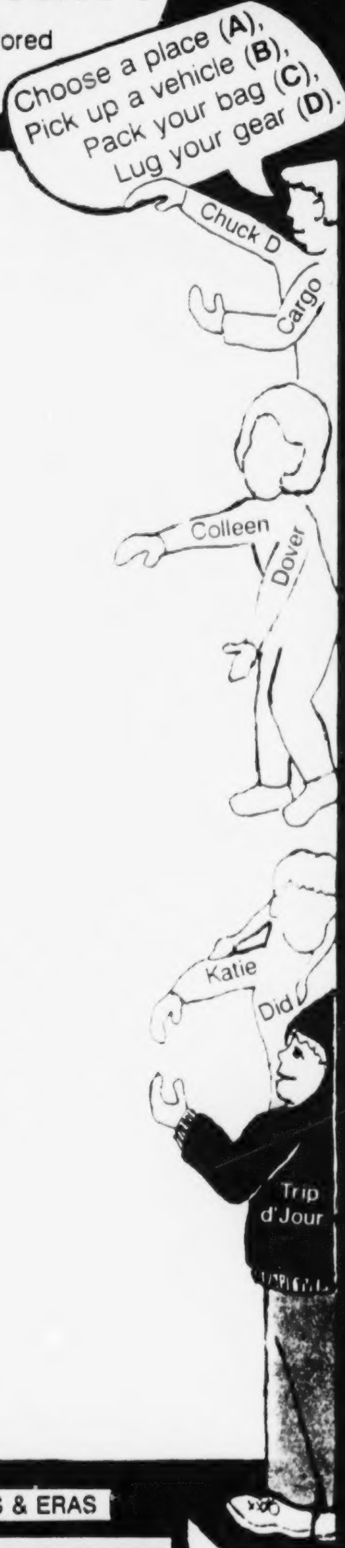
TRICERATOPS = three-horned face
SAURUS = reptile REX = king
BRONTO=thunder
STEGO=roof

WHERE SHALL WE START?

TO PLAY: Copy each section at right on a different colored paper; cut each word apart & fold it. Place in 4 piles & pick one from each. Draw your colorful adventure.

DRAW YOUR STUFF!

Ruby
Vali
Uri
Turn
Ethan
Digget


Choose a place (A),
Pick up a vehicle (B),
Pack your bag (C),
Lug your gear (D).
Chuck D
Cargo
Colleen
Dover
Katie
Did
Trip
d'Jour

What kind of scientist are you (pg. 19)?

What are you looking for?

What are you taking along?

GAME PIECES

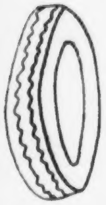
LOCATION

A

	pg.
Space	38
Volcano	8
Mountain	6
Fault	5
Observatory	19
Quarry	33
Ocean Floor	14
River	10
Glacier	9
Desert	24
City	39

TRANSPORTATION

B



Camel
Motorcycle
Land Rover
Dingy Row Boat
Car
Helicopter
Bicycle
Spaceship
Motor Boat
Airplane
Ocean Liner
Elephant

CLOTHING

C

Raincoat
Hiking Boots
Gloves
Flippers
Warm Parka
Spacesuit
Bathing Suit
Wading Boots
Jeans
Hard Hat
Heavy Coat

EQUIPMENT

D

Oxygen Mask
Scuba Gear
Pick Axe
Magnifying Glass
Notebook
Labels
Computer
Geiger Counter
Sample Bags
Oars
Anti-perspirant*
Shovel

TIME PERIODS

(where first found)
JURASSIC = Jura Mts. (Switz.)
PENNSYLVANIAN = the State
ORDOVICIAN = a tribe (Eng.)
MISSISSIPPIAN = Miss. River
PERMIAN = Perm Mts. (Rus.)

EPOCHS & ERAS

(Latin/Greek words)
ZOIC = life
CENE = new

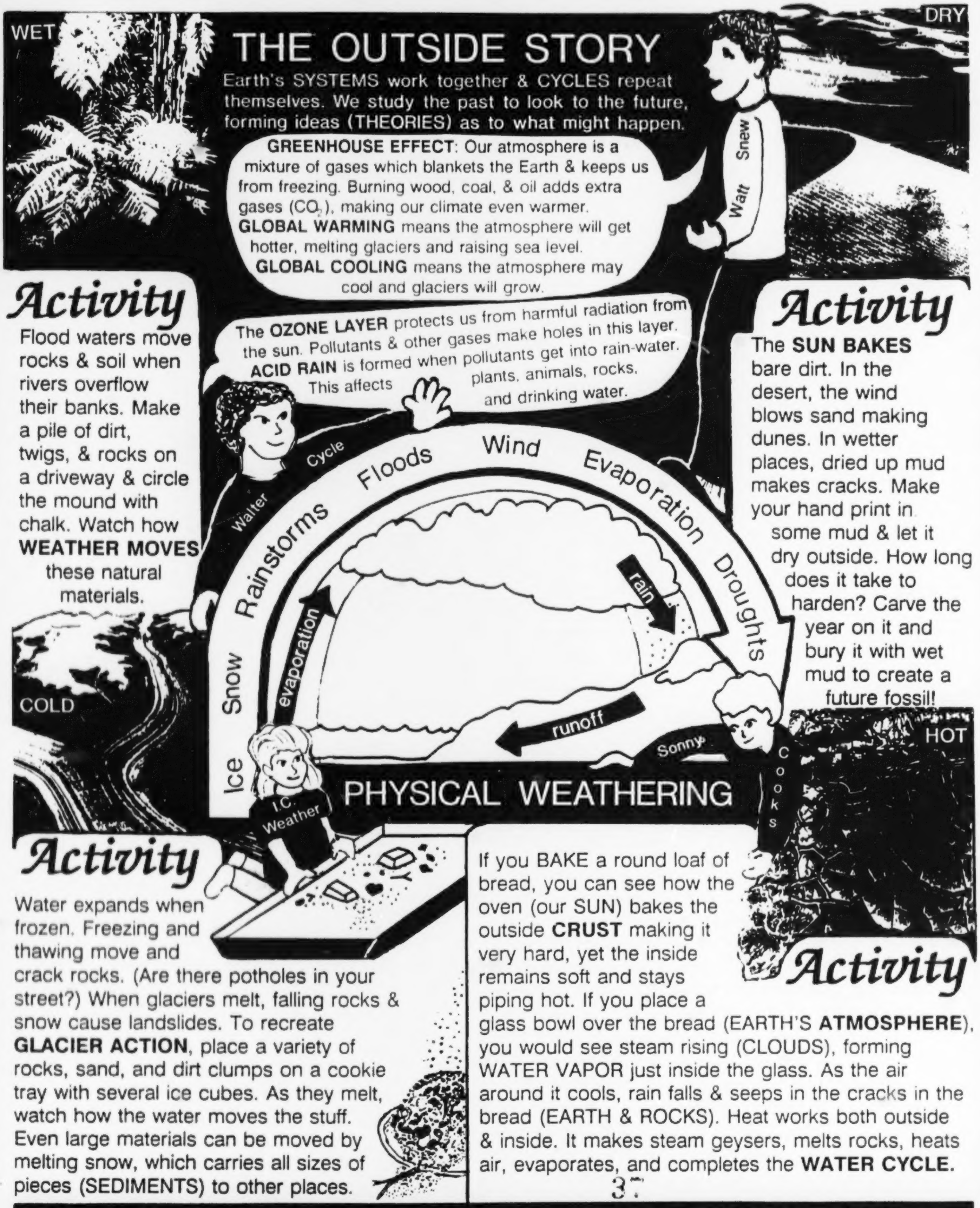
PALEO/MESO/CENO = ancient/middle/recent

*AMAZING ANTIDOTE

Geologists are often in poison ivy. They protect themselves at the start of the day by rubbing their exposed skin with anti-perspirant having aluminum. At night, they take their clothes off inside out and shower. Campers, remember this!

THE OUTSIDE STORY

Earth's SYSTEMS work together & CYCLES repeat themselves. We study the past to look to the future, forming ideas (THEORIES) as to what might happen.



GREENHOUSE EFFECT: Our atmosphere is a mixture of gases which blankets the Earth & keeps us from freezing. Burning wood, coal, & oil adds extra gases (CO_2), making our climate even warmer. **GLOBAL WARMING** means the atmosphere will get hotter, melting glaciers and raising sea level. **GLOBAL COOLING** means the atmosphere may cool and glaciers will grow.

The **OZONE LAYER** protects us from harmful radiation from the sun. Pollutants & other gases make holes in this layer. **ACID RAIN** is formed when pollutants get into rain-water. This affects plants, animals, rocks, and drinking water.

Activity

Flood waters move rocks & soil when rivers overflow their banks. Make a pile of dirt, twigs, & rocks on a driveway & circle the mound with chalk. Watch how **WEATHER MOVES** these natural materials.

Activity

The **SUN BAKES** bare dirt. In the desert, the wind blows sand making dunes. In wetter places, dried up mud makes cracks. Make your hand print in some mud & let it dry outside. How long does it take to harden? Carve the year on it and bury it with wet mud to create a future fossil!

Activity

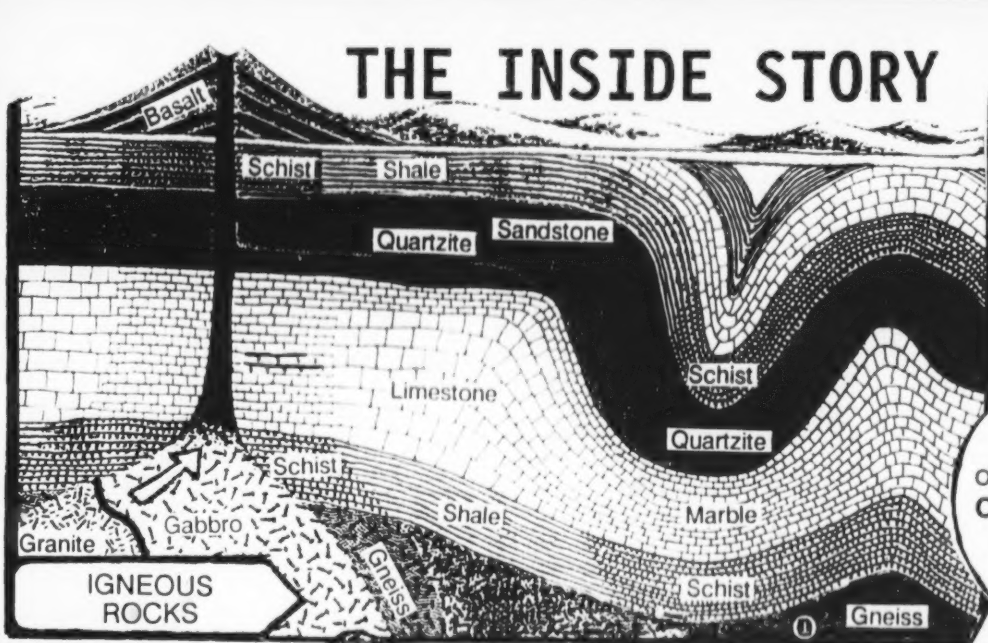
Water expands when frozen. Freezing and thawing move and crack rocks. (Are there potholes in your street?) When glaciers melt, falling rocks & snow cause landslides. To recreate **GLACIER ACTION**, place a variety of rocks, sand, and dirt clumps on a cookie tray with several ice cubes. As they melt, watch how the water moves the stuff. Even large materials can be moved by melting snow, which carries all sizes of pieces (SEDIMENTS) to other places.

Activity

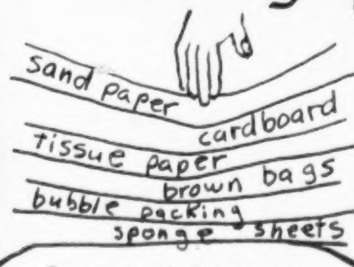
If you BAKE a round loaf of bread, you can see how the oven (our SUN) bakes the outside **CRUST** making it very hard, yet the inside remains soft and stays piping hot. If you place a glass bowl over the bread (EARTH'S **ATMOSPHERE**), you would see steam rising (CLOUDS), forming WATER VAPOR just inside the glass. As the air around it cools, rain falls & seeps in the cracks in the bread (EARTH & ROCKS). Heat works both outside & inside. It makes steam geysers, melts rocks, heats air, evaporates, and completes the **WATER CYCLE.**

Living RAIN FORESTS and WETLANDS produce much of Earth's OXYGEN & preserve SPECIES. When these places are cleared or burned, they affect our water cycle & our environment. To keep the system working, we need to CONSERVE nature.

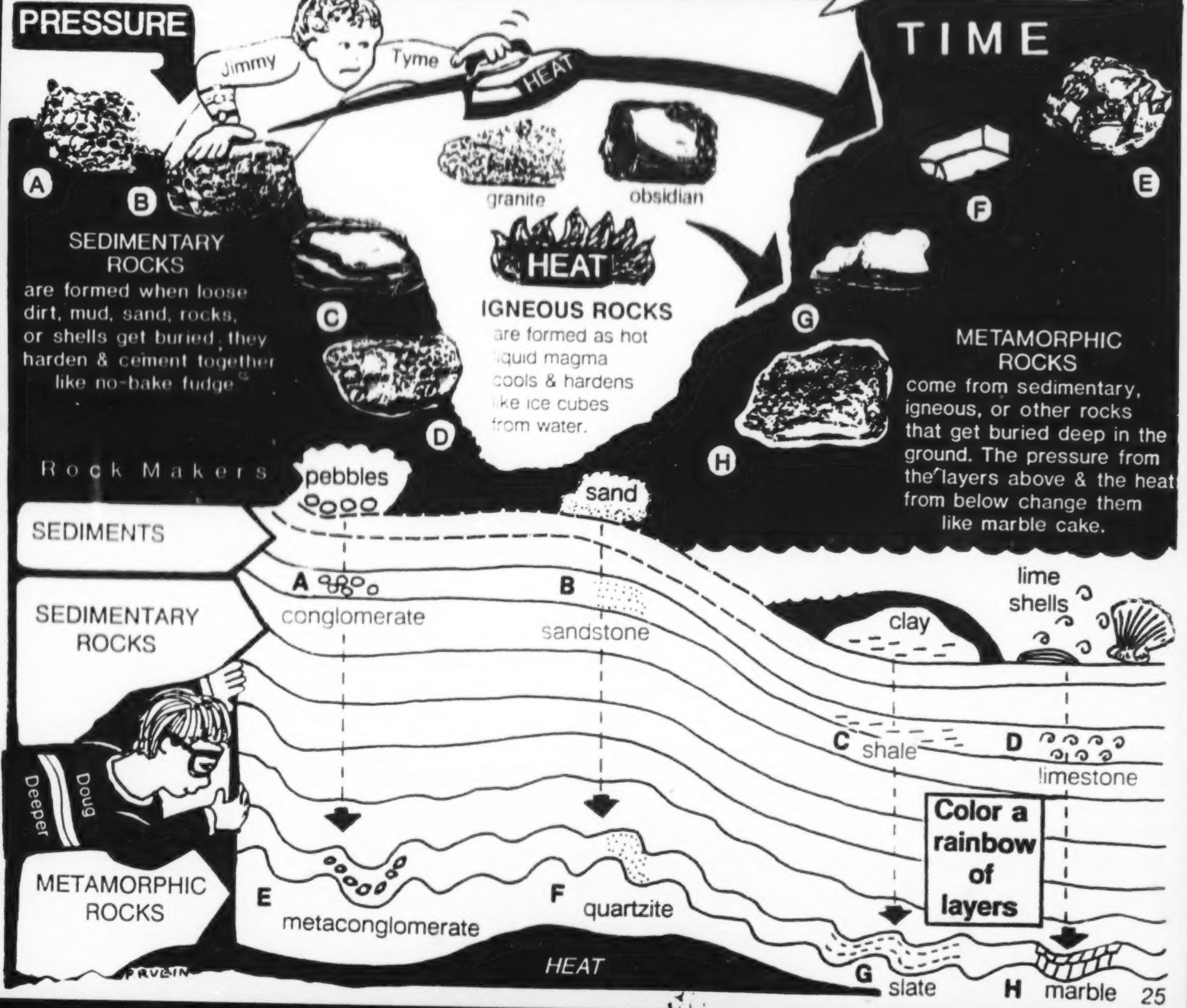
THE INSIDE STORY


Basalt
Schist
Shale
Quartzite
Sandstone
Limestone
Schist
Quartzite
Schist
Gabbro
Granite
Shale
Marble
Gneiss
Schist
Gneiss
IGNEOUS ROCKS

Activity


sand paper
cardboard
tissue paper
brown bags
bubble packing
sponge sheets

Some rock beds are harder & more solid, while others are softer. To see natural **COMPRESSION**, place different papers in a stack. Press the center. What happens at the edges? in the middle?

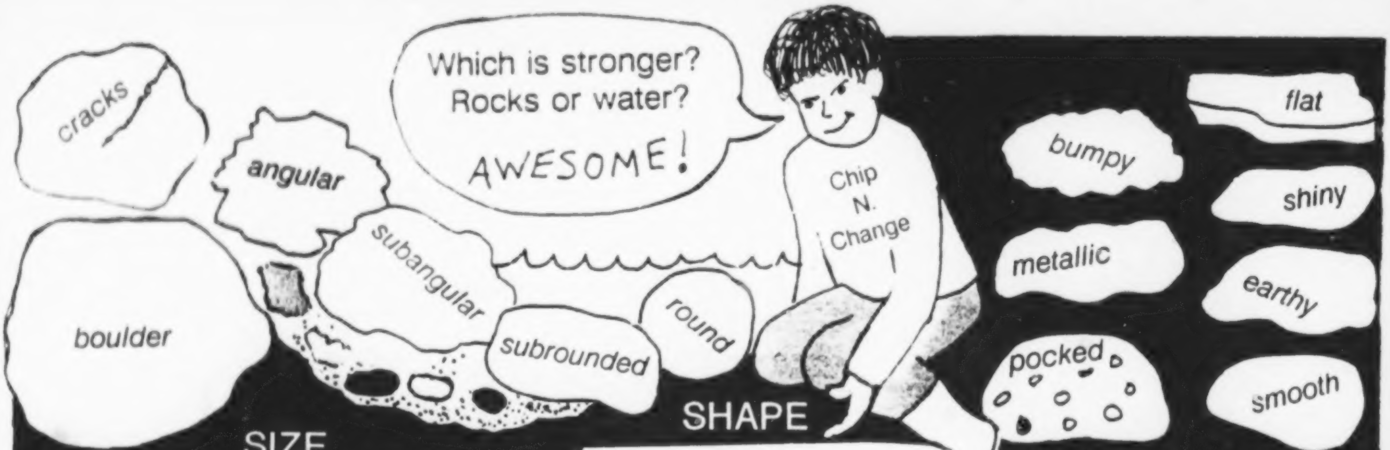

PRESSURE
Jimmy
Tyme
HEAT
TIME
A
B
C
D
E
F
G
H
granite
obsidian
HEAT
Rock Makers
pebbles
sand
SEDIMENTS
SEDIMENTARY ROCKS
A conglomerate
B sandstone
clay
lime shells
C shale
D limestone
Doug Deeper
METAMORPHIC ROCKS
E metaconglomerate
F quartzite
HEAT
G slate
H marble
PRUBIN

SEDIMENTARY ROCKS are formed when loose dirt, mud, sand, rocks, or shells get buried, they harden & cement together like no-bake fudge.

IGNEOUS ROCKS are formed as hot liquid magma cools & hardens like ice cubes from water.

METAMORPHIC ROCKS come from sedimentary, igneous, or other rocks that get buried deep in the ground. The pressure from the layers above & the heat from below change them like marble cake.

Color a rainbow of layers



SIZE

A

Rocks in the creek are pieces of still larger rocks that fell or broke apart. When rocks fall apart, they make SOIL. When rocks are in water, they bang together, breaking into smaller & smaller chips, making the edges smooth and round.

SHAPE

B

Many rocks are made of INTERLOCKING minerals. Some are harder/tighter. Some are softer/looser. Rocks crack into even, uneven, rough, & sharp pieces. Loosely BONDED rocks wear away faster, changing the size, shape, & texture of the chunks.

LUSTER & TEXTURE

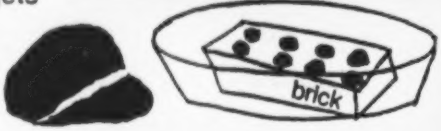
C

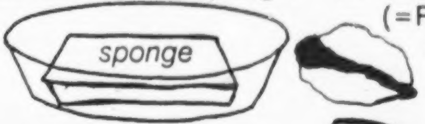
Depending on what rocks are made of & how they formed, many things can change them. Sometimes weather affects them and at times, ores & minerals seep in with water. The outsides & insides are always changing as they get WEATHERED & worn.

CHEMICAL WEATHERING

Activity

To see how **WATER SEEPS** & gets ABSORBED in the Earth's crust, place a dry sponge in a bowl & pour colored water around it. Wait & watch how the level of water rises up the sponge.





To test how **ROCKS HOLD WATER** (=POROUS) & minerals, use salt water & a dry brick. In a few days you'll see a CRYSTALLIZED layer (VEIN) through the brick.

Minnie
Moore

COLORS

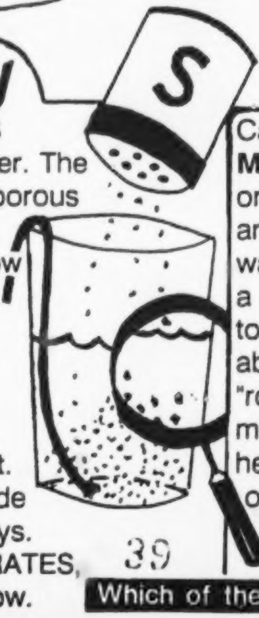
- ● red
- ● orange
- ● yellow
- ● green
- ● blue
- ● purple
- ● black
- ● gray
- ● white
- ● brown

D

Minerals come in different colors. The more of one color mineral in a rock, the more color is added (peek at pg. 3, Earthtones). CHEMICALS SEEP through cracks and holes, leaving deposits and creating CRYSTALS or VEINS. When all of the same mineral or chemical stays after the water evaporates or leaves, new colored layers can appear in rocks.

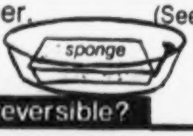
Activity

Some **MINERALS DISSOLVE** in water. The water seeps into porous places and into cracks. To test how minerals form crystals, fill a glass ¼ full of salt. Add just enough warm water to cover it. Hang a string inside and wait a few days. As water EVAPORATES, crystals of salt grow.



Activity

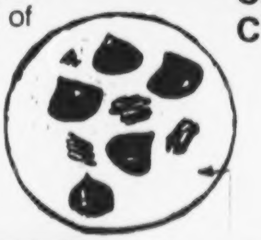
Carried by water, **METALS GATHER** to form ore. To see this action, put an iron nail in a bowl with water. After rust forms, add a dry sponge. Wait a few days to see how the rust gets absorbed by your sponge "rock." Inside the Earth, the metals seep into cracks, helping to form veins of silver or copper. (See pg.30)



Which of these is reversible? ?

MINERALS
Around Your House

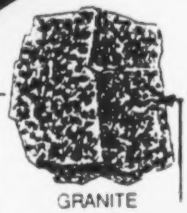
Like a cookie, a rock is made of different minerals.



GRANITE ROCKS

INGREDIENTS:
quartz, feldspar,
mica, & hornblende.

BAKE at 800° under pressure for 1000 years



CHOCOLATE CHIP COOKIES:

INGREDIENTS:
- ½ C white sugar
- ½ C brown sugar
- ½ C butter (creamed)
- ½ tsp vanilla
- 1 egg (beat in)
- 1 C & 2 T flour
- ½ tsp each salt & baking soda
- ½ C each chips & walnuts

Drop spoonfuls onto greased pan

BAKE at 375° for 10 minutes

Do you have a rock roof?

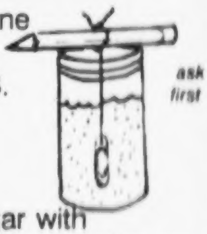
What happens when you fold a hot cookie? When it cools, can you unfold it? Think about how rocks & minerals soften when heated & get folded (just like mountain building!)

Miner
Problem

Activity ROCK CANDY

Rock candy shows how one mineral forms. Minerals can grow into **CRYSTALS**.

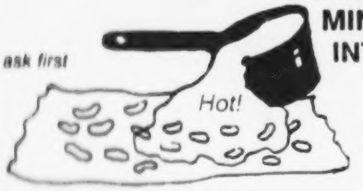
When all the same ingredients cool, they harden.



Dissolve 1 3/4 C of sugar with 1 C boiling water (HOT!). Wrap string on a pencil & weight the string with a paper clip at the bottom of a skinny jar. Pour in mixture. Cover with wrap & wait a week!

Activity PEANUT BRITTLE

shows how two **MINERALS GET INTERLOCKED**.



When hot liquid begins to harden, it grabs other minerals.

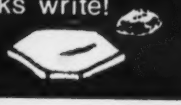
Lay 1/2 C unsalted, shelled peanuts on wax paper. Heat 2 C sugar to light brown syrup color (stir constantly). Pour over peanuts. Let cool! What happens?

THE GEMSTONES

RED	YELLOW	GREEN
ruby garnet	citrine	emerald tourmaline
BLUE	PURPLE	BLACK
sapphire turquoise	amethyst	onyx

Streak Test

When rocks and minerals are WEATHERED, it's hard to tell what's in them. Softer minerals will leave a streak of color if you draw a line with them on the back of a mosaic tile. See if your rocks write!



light bulbs: tungsten
roofs & driveways: tar
beams & magnets: iron
dry wall & plaster: gypsum
pipes & wiring: lead & copper
window glass & mirrors: silica
bathtubs & sinks: clay minerals

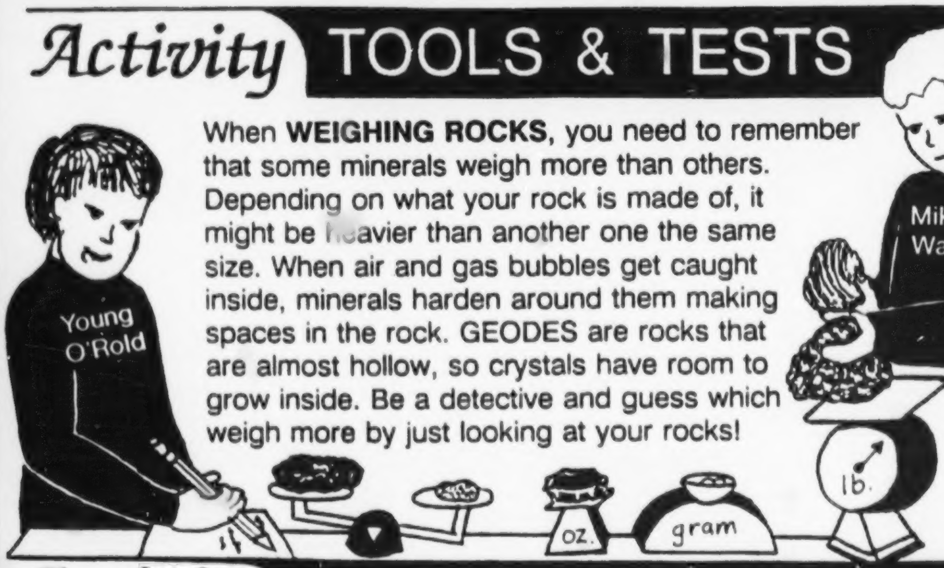
Get a piece of the planet!

Mimi Gotcha

OTHER STUFF MADE FROM MINERALS:
toothpaste - cleanser - potting soil - plant food
bicycles - teddy bears - clothes dryer - shovels
televisions - radios - refrigerators - cars - swings
eyeglasses - pencils - stove - pots & pans - carriages

Can you guess what these things are made of?

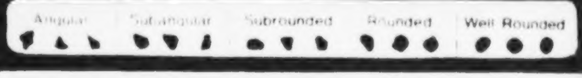
Activity TOOLS & TESTS *Activity*


Young O'Rold
Mikey Way
oz.
gram
lb.

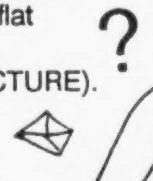
When **WEIGHING ROCKS**, you need to remember that some minerals weigh more than others. Depending on what your rock is made of, it might be heavier than another one the same size. When air and gas bubbles get caught inside, minerals harden around them making spaces in the rock. GEODES are rocks that are almost hollow, so crystals have room to grow inside. Be a detective and guess which weigh more by just looking at your rocks!

When **COLLECTING** rocks, take along markers, rulers, baggies, pad & pencil. In a notebook, write: DATE & PLACE, SHAPE, COLOR(S), SIZE, and TEXTURE. Make note of markings on rocks or ones that are shiny, metal-like or oily (LUSTER). Geologists don't always know what kinds they find! Look in books to identify your samples, or try the tests below.

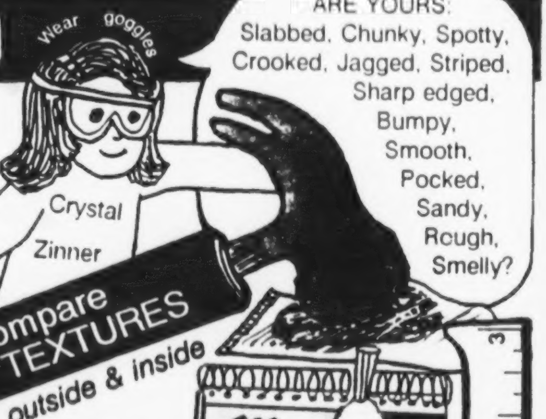
Activity

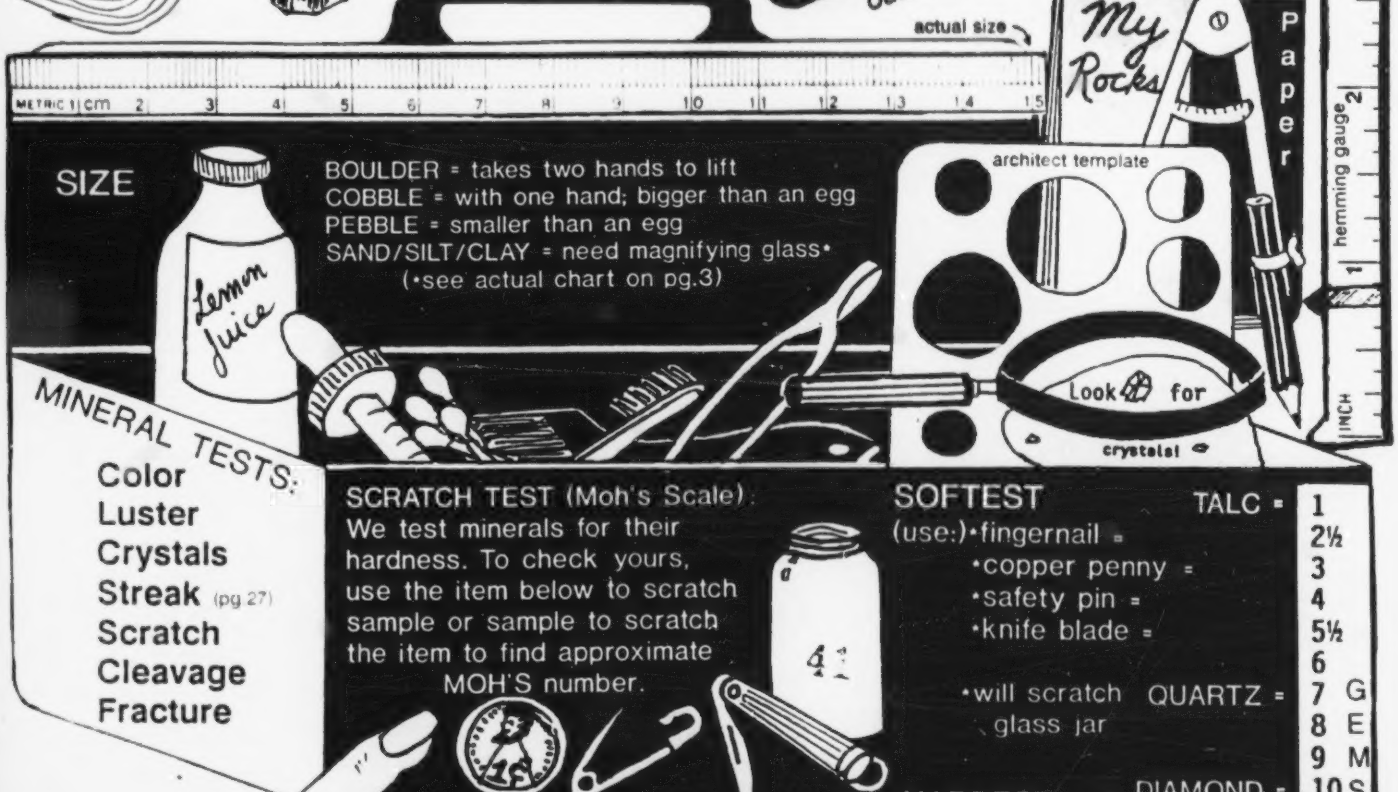

Angular
Subangular
Subrounded
Rounded
Well Rounded

Another way geologists tell what kind of rocks they find is by looking at how they formed. Some rocks form in flat thin layers or break with sharp edges (CLEAVAGE). **A TEST YOU CAN DO** is to break your rocks (FRACTURE). Put a rock in a plastic baggie and hit it with a hammer. If it is hard to break, the minerals inside are locked tightly together.



Guess before you crack them!


Wear goggles
ARE YOURS: Slabbed, Chunky, Spotty, Crooked, Jagged, Striped, Sharp edged, Bumpy, Smooth, Pocked, Sandy, Rough, Smelly?
Crystal Zinner
Compare TEXTURES outside & inside


actual size
METRIC 1 cm 2 3 4 5 6 7 8 9 10 11 12 13 14 15
My Rocks
Paper
architect template
hemming gauge
3
2
1
INCH
Lemon Juice
Look for crystals!
42

SIZE

BOULDER = takes two hands to lift
COBBLE = with one hand; bigger than an egg
PEBBLE = smaller than an egg
SAND/SILT/CLAY = need magnifying glass•
(•see actual chart on pg.3)

MINERAL TESTS:

- Color
- Luster
- Crystals
- Streak (pg 27)
- Scratch
- Cleavage
- Fracture

SCRATCH TEST (Moh's Scale). We test minerals for their hardness. To check yours, use the item below to scratch sample or sample to scratch the item to find approximate MOH'S number.

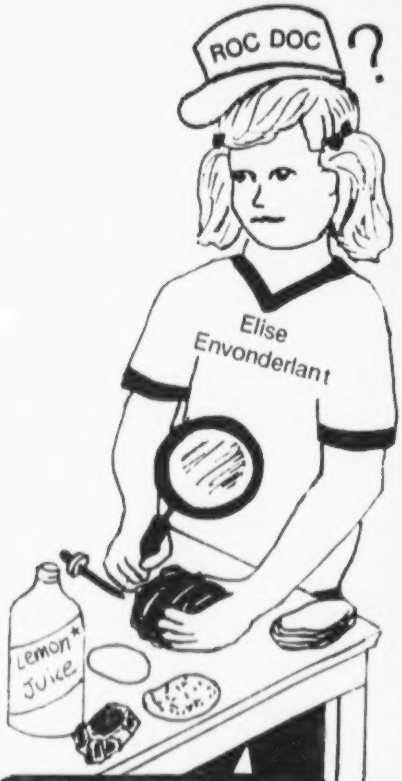
SOFTEST	TALC =	1	
(use:)•fingernail =		2½	
•copper penny =		3	
•safety pin =		4	
•knife blade =		5½	
		6	
•will scratch glass jar	QUARTZ =	7	G
		8	E
		9	M
HARDEST	DIAMOND =	10	S

ROCK HOUNDS ROCK HOUNDS

Remember to label rocks out in the field where you collect them. At home, paint a spot with white correction fluid, let dry. Write number, when dry, cover with clear nail polish.

Activity

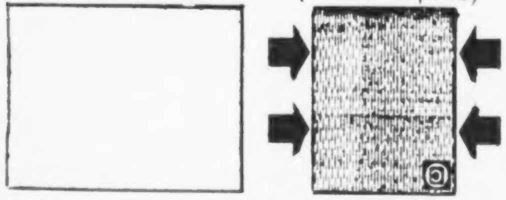
ROCK TESTS	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
SHAPE: round?						
angular?						
pointy?						
flattened?						
MARKS: spots-holes?						
stripes?						
POROUS: water drop seeps?						
COMPOSITION: all same?						
mixture?						
has crystals?						
drop of lemon juice* fizzes?						
TEXTURE: rough?						
smooth?						
wavy?						
sandy?						
TEMPERATURE: holds heat?						
feels cold?						
MINERAL TESTS						
COLOR: color(s)?						
same inside/outside?						
STREAK: (writes on tile back) yes/no?						
color?						
SHINE (LUSTER): shiny?						
metallic/not?						
oily?						
HARDNESS: scratched with what tool?						
FRACTURE: curved?						
straight lines (cleavage)?						
breaks easily or not?						



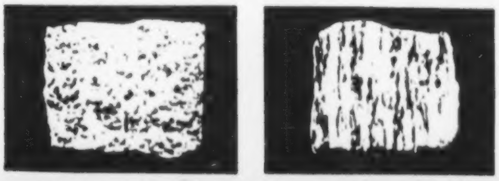
The history of rocks

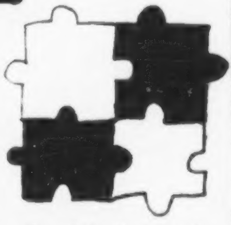
Rock & Roll

Activity

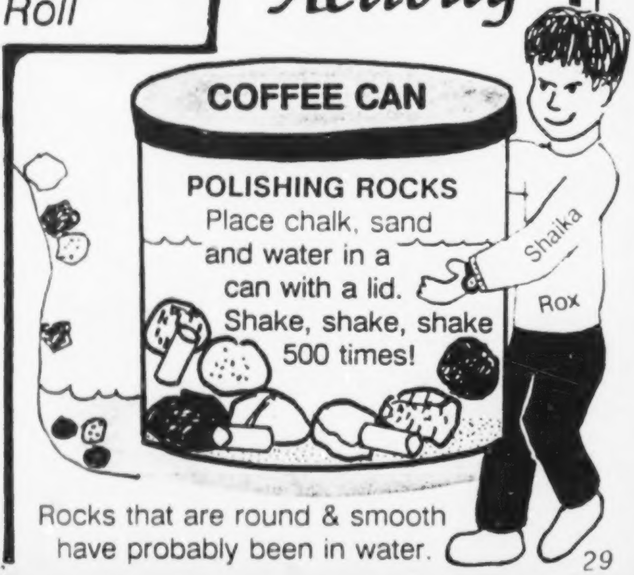


When squished, SPOTS become STRIPES!





Crystals interlock or line up.



COFFEE CAN

POLISHING ROCKS

Place chalk, sand and water in a can with a lid. Shake, shake, shake 500 times!

Rocks that are round & smooth have probably been in water.

YESTERDAY'S INVENTIONS

Activity

Once Upon A Time, before we lived in cities, people wandered in small groups. As they needed things, they used what they saw around them. Earth's natural resources have given us many useful products.

Imagine that nothing was invented yet. What would you NEED, SEE, or FIND to use? How would you invent things? Figure out the steps!

Michelle
Finda

BE THE FIRST PERSON ON EARTH:

How would you know what would be safe to eat? What clues do you have? How do you think people found out they could **MINE & MIX** materials from inside the Earth?

		FOOD	**SHELTER**	**CLOTHING**
	TOOLS	**HEAT**	**PROTECTION**	**HEALTH CARE**
JOBS	**ECONOMY**	**ENERGY**	**MOBILITY**	**TECHNOLOGY**

Howie
Gett N.
Hughes

EARTH$

PRODUCT$

TODAY

$$ MONEY UNDER YOUR FEET $$

Lisa
Autono

Each American uses 40,000 pounds of minerals every year!

CARS GROW !?!

Body/engine	- metals
Trim (bumpers)	- chrome
Windows	- silica sand
Wiring	- copper
Knobs/handles	- oil
Tires	- sulfur
Lubricants	- oil
Gasoline	- refined oil
Brakes	- asbestos

Over long periods of time, under heat and pressure, many things form in the layers of the Earth.

METALS can be made from ores; these SOLIDS can be dug out. If heated, these materials can be bent (MALLEABLE) and can be shaped into useful products. Some metals can pass heat (CONDUCTORS), or can be combined (ALLOYS) to make stronger metals that will not rust.

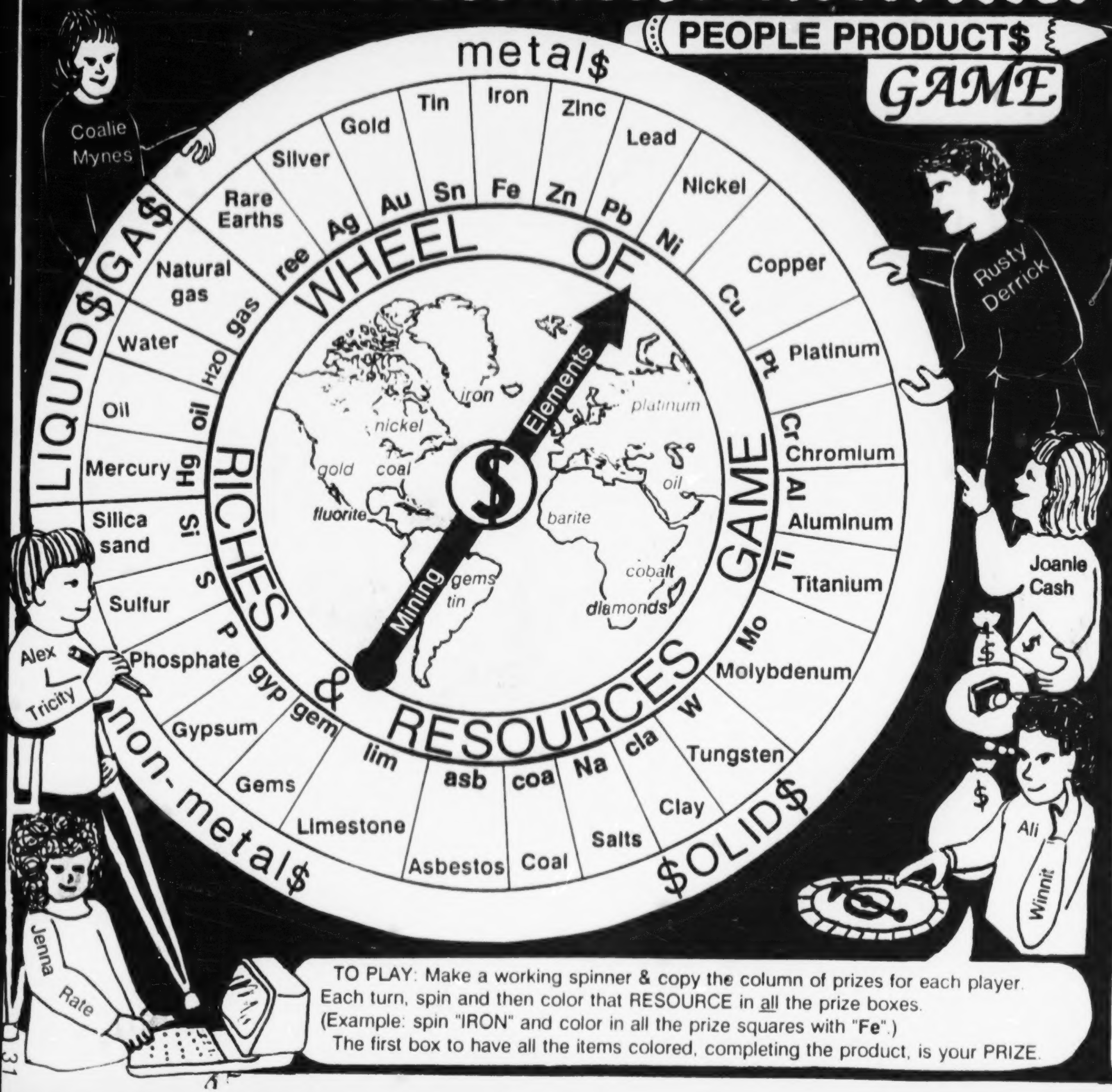
NON-METALS can be ground up and combined to make chemicals and medicines.

ROCKS & GRAVEL can be used for roads and buildings.

LIQUIDS & GASES can be used for heating houses & running machines such as cars and engines.

WIN WHAT YOU SPIN!

PEOPLE PRODUCT$ GAME


metal$
Tin
Iron
Zinc
Gold
Lead
Silver
Nickel
Rare Earths
Copper
Natural gas
Platinum
Water
Chromium
Oil
Aluminum
Mercury
Titanium
Silica sand
Molybdenum
Sulfur
Tungsten
Phosphate
Clay
Gypsum
Salts
Gems
Coal
Limestone
Asbestos
Ag
Au
Sn
Fe
Zn
Pb
Ni
Cu
Pt
Cr
Al
Ti
Mo
W
cla
Na
coa
asb
lim
gem
gyp
P
S
Si
Hg
oil
H2O
gas
ree
LIQUID$
GA$
non-metal$
$OLID$
WHEEL OF RICHES & RESOURCES GAME
Mining
Elements
$
iron
nickel
gold
coal
fluorite
platinum
oil
barite
gems
tin
cobalt
diamonds
Coalie Mynes
Rusty Derrick
Joanie Cash
Alex Tricity
Ali Winnit
Jenna Rate
$

TO PLAY: Make a working spinner & copy the column of prizes for each player. Each turn, spin and then color that RESOURCE in all the prize boxes. (Example: spin "IRON" and color in all the prize squares with "Fe".) The first box to have all the items colored, completing the product, is your PRIZE.

STEREO	COMPUTER
○ case - oil ○ tape - Cr,Fe,oil ○ record - oil ○ paint - Ti, oil ○ needle - Cr,gem	○ case - oil,Fe ○ wires - Cu,Au ○ circuit boards - cla ○ monitor - ree,Si
DINNERWARE	**TOASTER OVEN**
○ dishes - cla,Si ○ glasses - Na,Si ○ silverware - Fe or Ag ○ casting - Si, H_2O	○ wiring - Cu ○ case - Al,Fe,oil ○ heating elements - W or Ni,Cr ○ glass - Si
NEW CAR	**FREE CASH**
(see above) ○ engine - Fe or Al ○ exhaust system - Pt ○ trim - Cr,Zn ○ gasoline - oil ○ battery - Pb	○ coins - Fe,Zn,Cu ○ paper - cla ○ ink - oil ○ molds - Fe,Cr,Ni
NEW HOUSE	**REFRIGERATOR**
○ foundation -lim,H_2O ○ roof - asb,oil ○ walls - gyp ○ siding - Al ○ pipes & wire - Cu ○ thermostat - Hg	○ body - Fe or Al ○ wires - Cu ○ molding - oil ○ paint - Ti,oil ○ light - W
FREE FOOD	**AIRPLANE TRIP**
○ preservatives -Na ○ fertilizer - P,S ○ machinery - Fe,Cr ○ cans - Fe,Sn or Al ○ irrigation - H_2O	○ airplane - Al,Ti ○ wiring - Cu ○ fuel - oil ○ engine - Fe,Cr,Mo
JEWELRY	**CAMERA**
○ metal - Au,Ag,Pt ○ molds - Si,Cr ○ stones - gem ○ heat - oil,gas,coal	○ film - Ag,oil ○ body - Al,Fe ○ strap - oil ○ lenses - Si,Na ○ paper - cla

How the Earth makes

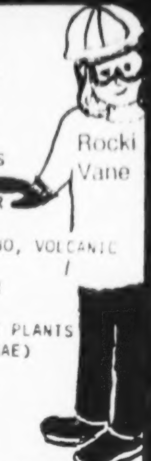
PRECIOUS STUFF

MATCH THE RESOURCE WITH THE REBUS

LEGEND..........

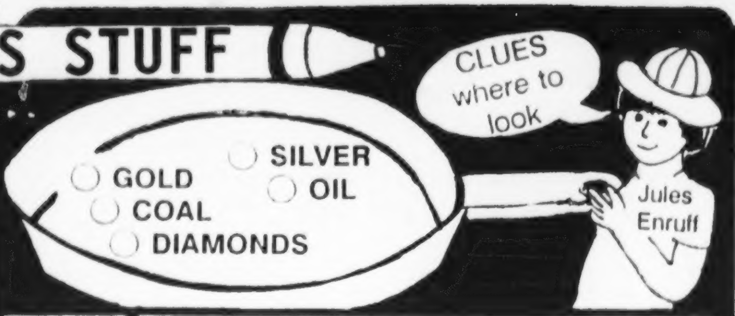
💡	IDEA
🌍	EARTH
💧	WATER
△▲	METALS
Ag	SILVER
🌋	VOLCANO, VOLCANIC
S	SULFUR
🌱🌱	LITTLE PLANTS (ALGAE)
🌊	OCEAN
▦	FLOOR
••••	GRAINS OF DIRT (SEDIMENT)
🥫	CAN
🛢	OIL
🌲🌳	TREES
🗜	PRESSED
●●	COAL
🔥	HOT, HEAT
●○●	ROCKS
Kt.	GOLD
〰	CRACKS
☁	WEATHER
▣	MANTLE
⌐	PIPE
🚜	STEAM SHOVEL
⛏	DIG
◆◆	DIAMONDS

47



Robbie
Feingold

Cory
Mineshaft


CLUES
where to
look
Jules
Enruff

○ GOLD ○ SILVER
○ COAL ○ OIL
○ DIAMONDS

1 1 💡 IS THAT DEEP IN THE 🌍, GROUND-💧 DISSOLVES PRECIOUS △▲ LIKE Ag. THE 💧 MOVES (2) THE SURFACE WITH 🌋 LAVA. IT DEPOSITS Ag MIXED WITH S MINERALS.

2 🌱🌱 LIVED IN THE 🌊, DIED & FELL (2) THE ▦. THEY GOT BURIED BY OTHER •••••. AFTER MANY YEARS OF BURIAL & 🔥, U 🥫 FIND 🛢.

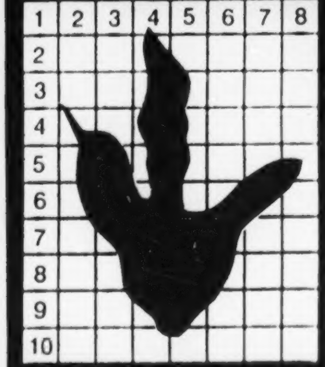
3 🌲🌳 DIED & GOT BURIED IN THE 🌍 WITH OTHER •••••. IF THEY GET 🗜, THEY BECOME ●●.

4 🔥 💧, - DEEP WITHIN THE 🌍 MOVES THROUGH OLDER ●○○● THAT HAD Kt.. THE 💧 PICKS ⇧UP THE Kt. & MOVES IT (2) THE SURFACE WITH QUARTZ ALONG 〰. WHEN THE ●○○● ☁, THE Kt. IS ⇦LEFT BEHIND.

5 THESE R MADE 13 MILES IN THE ▣. IF A 🌋 BLOWS A HOLE IN THE 🌍'S SURFACE & FORMS A ⌐, AFTER THE ●○○● ☁ (2) BLUE DIRT, A 🚜 🥫 ⛏ & FIND ◆◆.

I wonder
how most gems
form?
When
certain chemicals
come together
and cool slowly,
colored crystals can
grow.
Julie
Geode
James
Stone

(peek on pg 26-28)



Activity

In Culpeper, Virginia, 2,000 fossil footprints were found in a rock quarry. To copy this unknown **DINOSAUR FOOTPRINT**, use a sheet of graph paper & grid the lines. Enlarge your footprint to 8" x 10".

Althea
Gone

AMAZING ANECDOTE

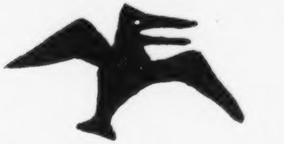
When my co-author sister was visiting my house, she said she could get me a casting of a dinosaur track. She said she would bring it when visiting again. When she got home, she called & said she left her field shoes at my house. I mailed her one shoe with a note saying: "You don't walk around this planet until I get my dinosaur track!"

GAME DINOSAURS

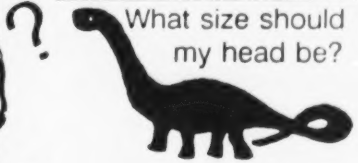
S	N	A	I	B	I	H	P	M	A	N
C	E	D	Y	E	G	G	S	A	T	O
S	P	I	S	S	O	P	U	P	B	R
A	T	M	P	U	X	E	R	A	S	P
R	E	E	O	R	E	T	U	T	U	E
E	R	T	T	U	D	Y	A	O	R	N
C	O	R	A	S	I	N	S	S	U	T
I	D	O	R	E	N	O	O	A	A	H
O	A	D	E	L	O	P	N	U	S	E
Z	C	O	C	I	S	E	N	R	O	B
O	T	N	I	T	A	O	A	U	G	A
S	Y	L	R	P	U	P	R	S	E	L
E	L	A	T	E	R	L	Y	S	T	H
M	S	E	G	R	S	E	T	Z	S	A

FIND ME
Dinosaurs
Mesozoic Era
Reptiles
Eggs
Amphibians
Apatosaurus
Dimetrodon*
Stegosaurus
Pterodactyls*
Triceratops
Tyrannosaurus
rex
No people

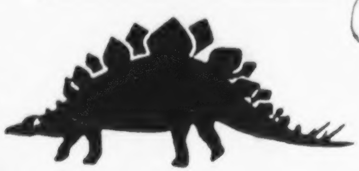
WHO AM I? *GAME*



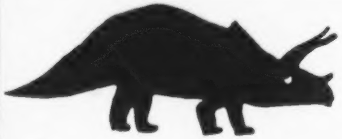
1* ____________________



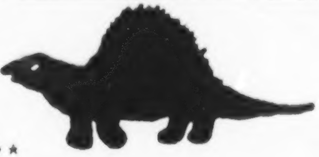
2 ____________________



3 ____________________



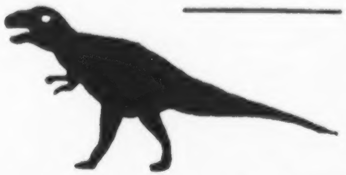
4 ____________________



5* ____________________

6 ____________________

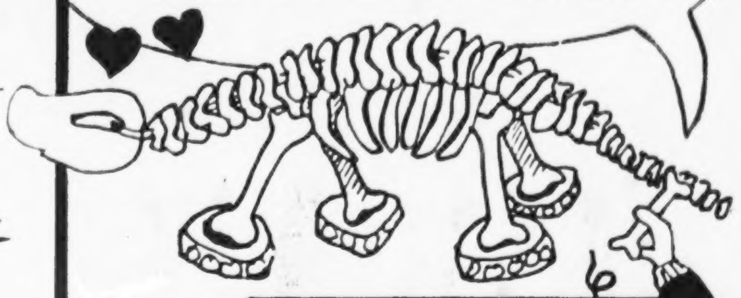
____



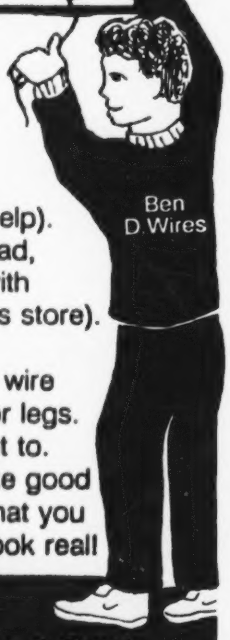
*These are not dinosaurs!

KEEPING AHEAD

FACT: Museums pay more money for whole fossil skeletons.
REAL LIFE: Paleontologists fight to find them.
WHAT WOULD YOU DO?: In the 1870's, a famous fossil hunter found pieces of Apatosaurus first, and then a more complete skeleton and named it Brontosaurus. Neither frame had a head, so he added a small head from the same area. The press loved the Brontosaurus find, but several years later, someone discovered the cover-up! Didn't you ever wonder how such a small jaw could get enough food to feed a huge body? Today we know which head belongs with the dinosaur body and we use the original name, Apatosaurus.



Activity



MAKE A TURKEYSAURUS ①

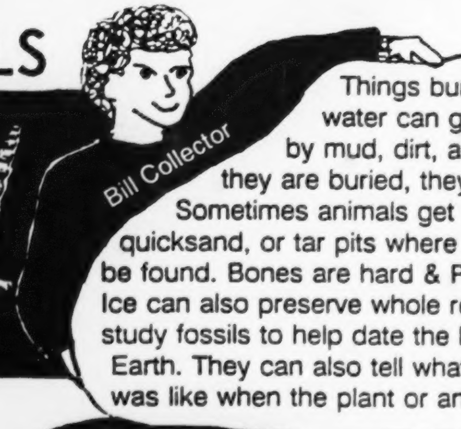
SET UP: Clean chicken and turkey bones using water & bleach (with help). With telephone wires or strong thread, attach bones to framework made with pliable ground-wire (from electronics store).

WORK: String neck bones on main wire to form spine. Wire bigger bones for legs. Add a rib cage & anything you want to. Round bones & salmon bones make good feet & toes. Look for other bones that you could add to make your dinosaur look real!

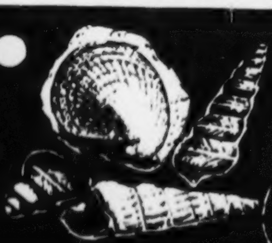
FOOTNOTE

To be correct, always underline Latin & Greek names. For other name facts, peek on pg. 22.

THE WORLD OF FOSSILS



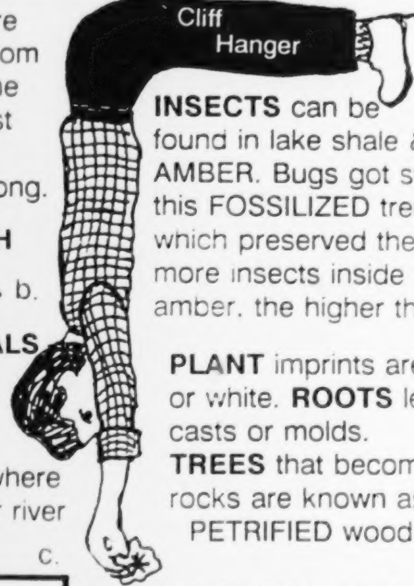
Things buried near water can get covered by mud, dirt, and gravel. If they are buried, they turn into rocks. Sometimes animals get stuck in swamps, quicksand, or tar pits where their soft parts can be found. Bones are hard & PRESERVE easily. Ice can also preserve whole remains. Scientists study fossils to help date the layers of the Earth. They can also tell what the climate was like when the plant or animal lived.



FISH. Bones, scales, & teeth are all that remains from water animals. The skull of the largest fossil fish ever found was 10 ft long. a.

BONES & TEETH b.

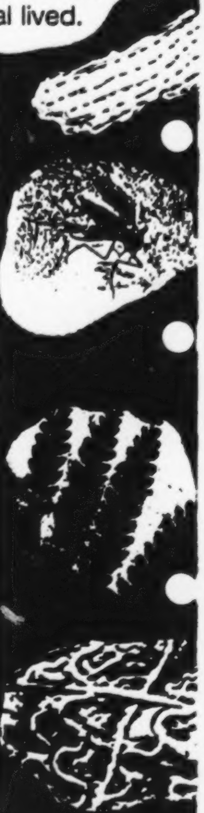
SHELLS & CORALS are skeletons that can turn into rock by being buried. They tell where an ocean, lake, or river used to be. c.



INSECTS can be found in lake shale & in AMBER. Bugs got stuck in this FOSSILIZED tree sap, which preserved them. The more insects inside the amber, the higher the price! d.

PLANT imprints are black or white. **ROOTS** leave casts or molds. **TREES** that become rocks are known as PETRIFIED wood. e.

WORM HOLES & BURROWS are signs of past life. Go to creeks & look for rocks with marks you cannot explain. They may be tracks from yesteryear! f.



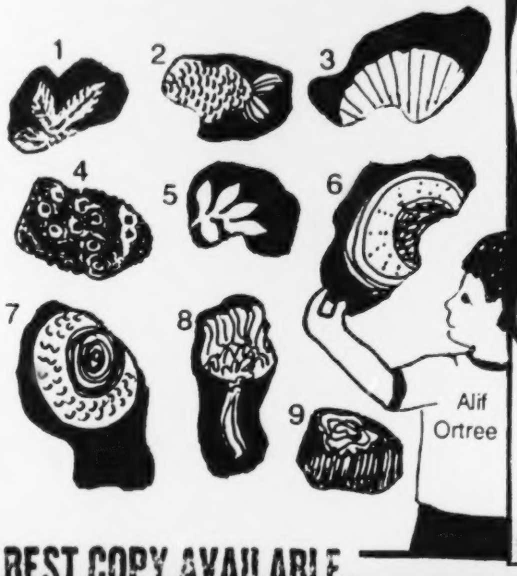
TRACKS & BODY MARKS: g. As animals drag their bodies along muddy paths, they leave trails. If trails get filled with clay that hardens, fossilized marks can be seen. Rock quarries are good places to find these along with footprints.

PLANT OR ANIMAL GAME

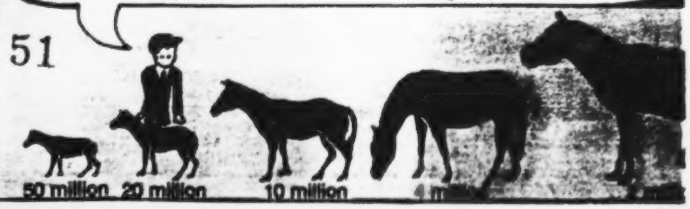
Paleontologists usually find pieces (FRAGMENTS) of fossilized remains. Can you identify these?

A=animal **P**=plant **?**=not sure

1 [ ]
2 [ ]
3 [ ]
4 [ ]
5 [ ]
6 [ ]
7 [ ]
8 [ ]
9 [ ]



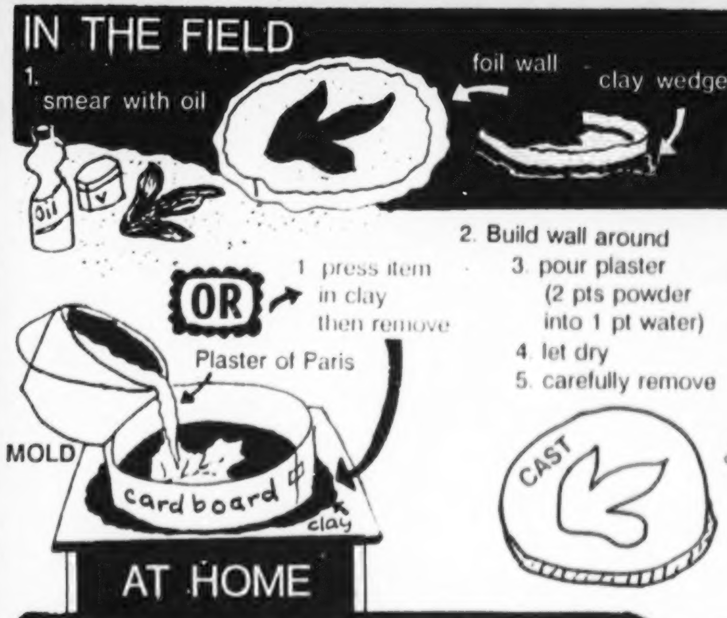
SKELETONS show how things have grown over the years. Look how big horses have gotten over millions of years!



BEST COPY AVAILABLE

MAKING FOSSILS

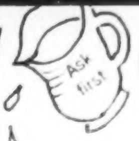
IN THE FIELD


1.
smear with oil
foil wall
clay wedge
Oil
V
OR
1. press item
in clay
then remove
2. Build wall around
3. pour plaster
(2 pts powder
into 1 pt water)
4. let dry
5. carefully remove
Plaster of Paris
MOLD
cardboard
clay
CAST

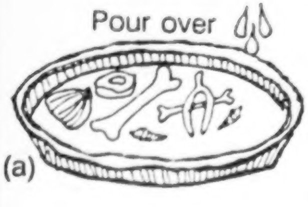
AT HOME

Raleigh Punnie

Activity

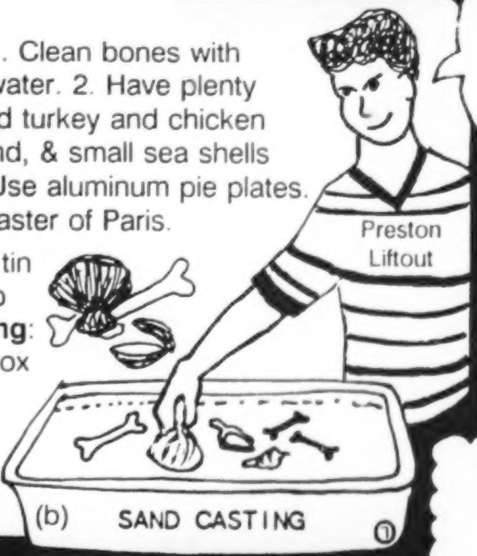


MAKING MOLDS AND CASTS



SET UP: 1. Clean bones with bleach & water. 2. Have plenty of bleached turkey and chicken bones, sand, & small sea shells on hand. Use aluminum pie plates. 3. Need plaster of Paris.

WORK: 3. (**a**) Sprinkle sand in pie tin and then place bones and shells to make a design. (**b**) or **Sand Casting**: press them into wet sand in sandbox and carefully remove. 4. **Then** mix plaster & pour it over them, place a bent pipe cleaner in wet plaster for hanging, and let dry.


Preston Liftout
(b)
SAND CASTING

LASTING IMPRESSIONS

What did one **ROCK** say to the other **ROCK**? (You crack me up!)

What did one CONTINENT say to the other? (It's not my FAULT!)

What did the **DIAMOND** have for lunch? (14 CARATS)

What did the **VOLCANO** say to the **ROCK**? (Don't eat too much **BASALT** & have a **GNEISS** day!)

Knock knock. Who's there? **GRANITE**. Granite who? Don't take me for granite!

How do you know when a **VOLCANO** is angry? (It blows its top!)

Who is the politest ancient reptile? (A plesiosaur.)

What did the **GOLD MINER** say to the **CREEK**? (What's yours is yours, & what's **MINE** is mine.)

What did one **FOSSIL** say to the other? (I'm older than you!)

What did the mountain say to the VOLCANO? (You're hot stuff!)

What did the **GLACIER** say to the mountain? (I've got you on ice!)

What did the mama **ROCK** do when the baby rock cried? (She rocked her to sleep!)

What did one **STREAM** say to the other? (I can run faster than you!)

What did the **ROUND ROCK** say to the **SQUARE ROCK**? (Get in shape.)

CAN YOU MAKE UP A GEOLOGY JOKE?

GEO JOKES

WHERE IN THE WORLD GAME

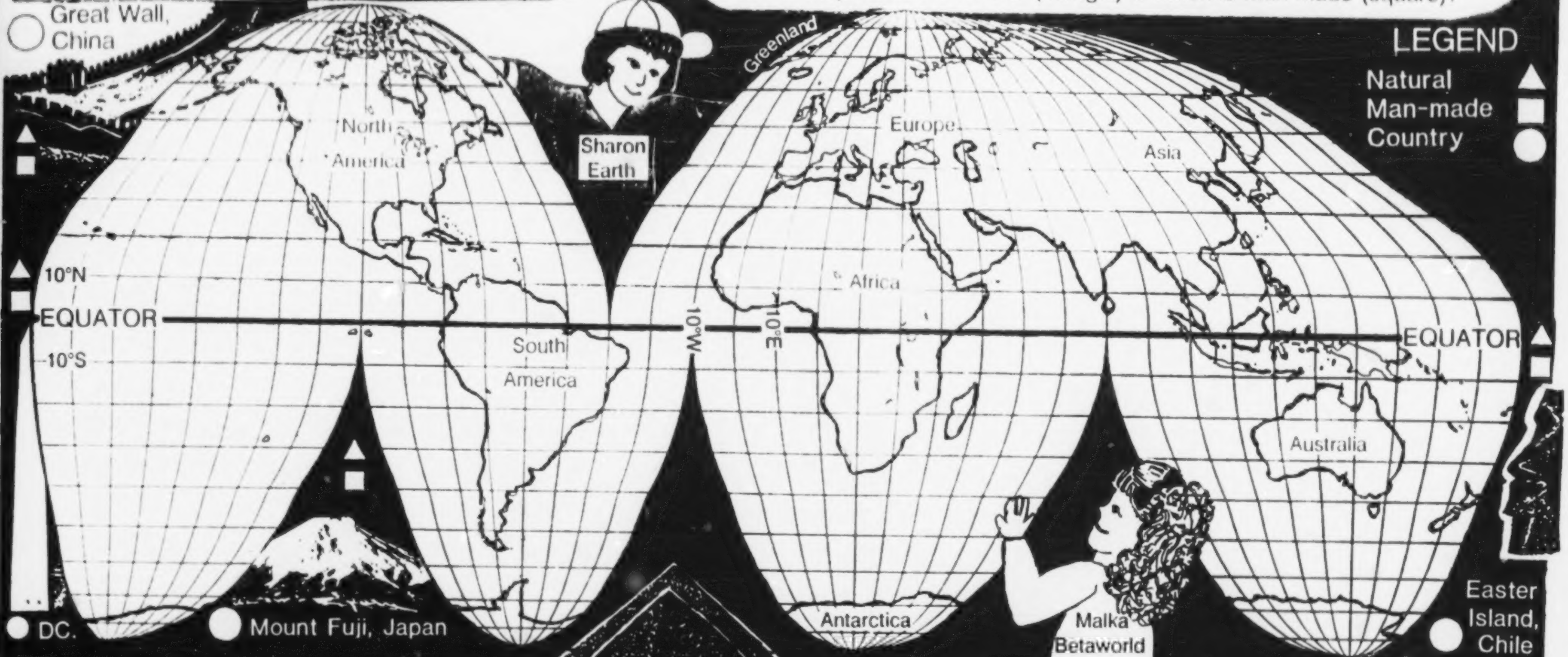
TO PLAY. Color the circle at each FAMOUS ROCK below. Then color its location on the map. Which is natural (triangle) & which is man-made (square)?

LEGEND

Natural ▲

Man-made ■

Country ●


Greenland
North America
Europe
Asia
Africa
South America
Australia
Antarctica
10°N
EQUATOR
10°S
10°W
10°E
EQUATOR
Sharon Earth
Malka Betaworld
▲
■

○ Great Wall, China ▲ ■

● DC. ▲ ■

● Mount Fuji, Japan ▲ ■

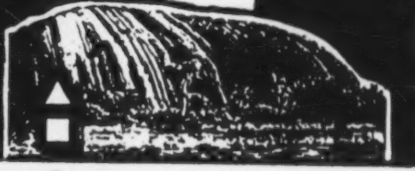
● Easter Island, Chile ▲ ■

▲ ■

○ Stonehenge, England

▲ ■

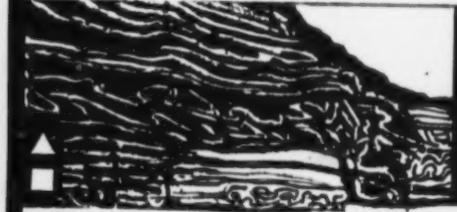
○ Pyramids, Egypt


▲ ■

○ Ayers Rock, Australia

▲ ■

○ Basalt pavement, Iceland


▲ ■

○ Flour Cave, Israel

▲ ■

○ Taj Mahal, India

▲ ■

○ Roman Forum, Italy

▲ ■

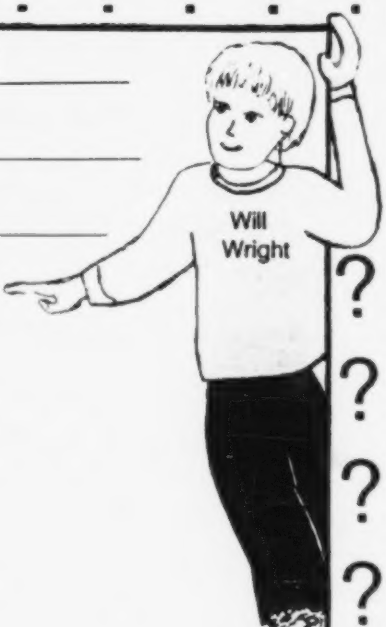
○ Machu Picchu, Peru

Places to visit in the USA
Devils Tower, WY
Natural Bridge, UT
Camel Rock, NM
Lincoln Memorial
Mt. Rushmore, SD

NAME ____________________ AGE ________

ADDRESS ______________________________

CITY ______________ STATE ________ ZIP ________



Will Wright

WHAT DO YOU WONDER ABOUT?

I'M CURIOUS ABOUT...

Rachel Kenrite

MY FAVORITE:

ROCK...	ACTIVITY... GAME... CHARACTERS...

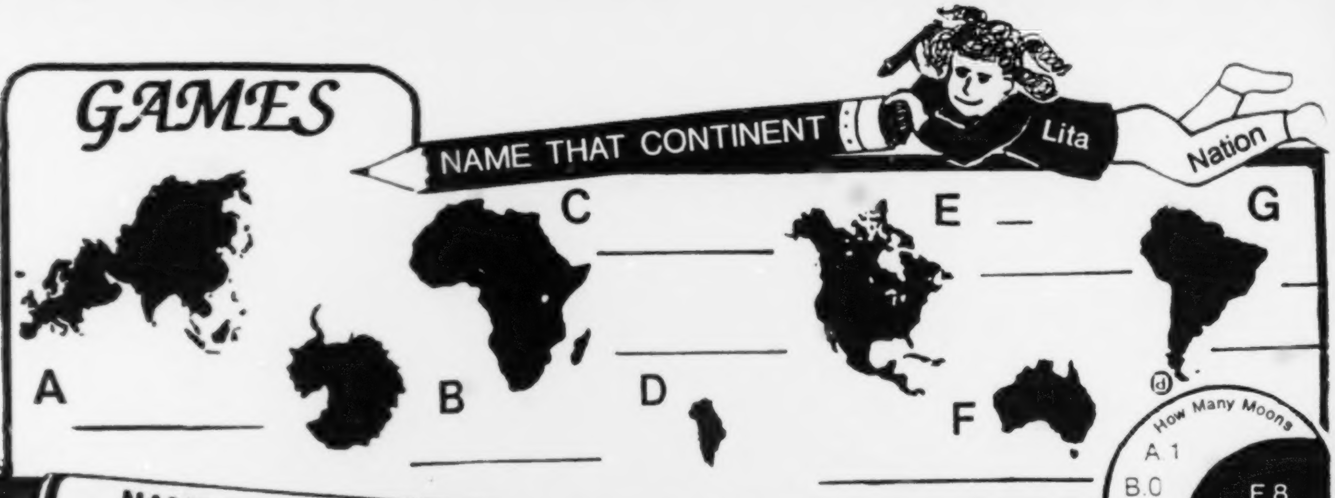
Yukon Sendus

MY ROCK JOKE...

Copy & send to:

Earth Science Information Center
Attn: Penni Rubin or Dr. E.I. Robbins
U.S. Geological Survey
507 National Center
Reston, VA 22092

GAMES


NAME THAT CONTINENT
Lita
Nation
A
B
C
D
E
F
G

NAME THAT PLANET
Guessa Planet

SIZE UP THE PLANETS

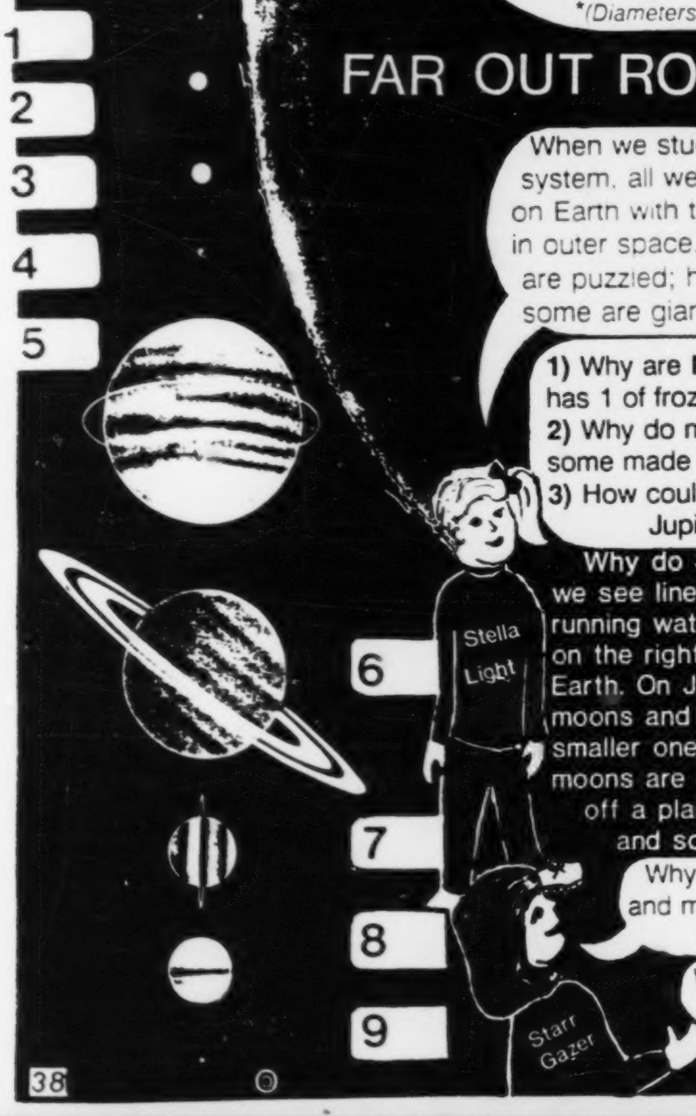
HINTS:

A.Pluto	(2,300)*	E.Earth	(12,800)
B.Mercury	(4,900)	F.Neptune	(45,500)
C.Mars	(6,800)	G.Uranus	(51,100)
D.Venus	(12,100)	H.Saturn	(120,500)
		I.Jupiter	(143,000)

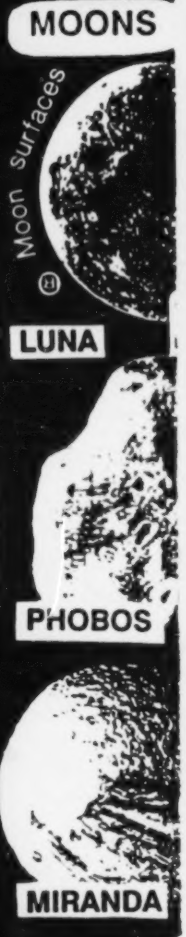
*(Diameters in km)

How Many Moons

A.1
B.0
C.2
D.0
E.1
F.8
G.15
H.18
I.16


1
2
3
4
5
6
Stella Light
7
8
9
Starr Gazer

MOONS


Moon surfaces
LUNA
PHOBOS
MIRANDA

FAR OUT ROCKS IN SPACE

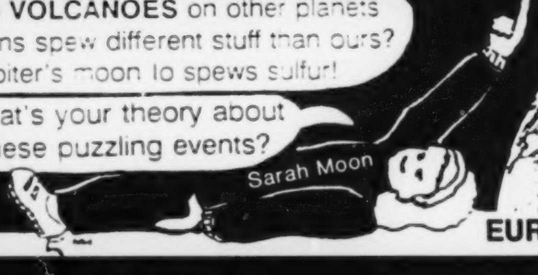
When we study planets and moons in our solar system, all we can do is compare what we see on Earth with the images sent back from cameras in outer space. Many times even the scientists are puzzled; how come some planets are rocky & some are giant balls of gas? Other puzzles are:

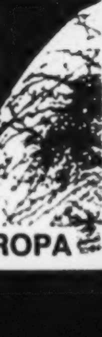
1) Why are **POLES** made of different stuff? Mars has 1 of frozen water & 1 covered by frozen gas.
2) Why do most planets have **RINGS**? And why are some made of ice & others made of rock chunks?
3) How could **STORMS** be as big as the Earth on Jupiter or cover all of Mars?

Why do SURFACES vary so much? On Mars, we see lines that look like rivers, but there's no running water now. The images of the MOONS on the right don't look like anything we see on Earth. On Jupiter and Saturn, there are small moons and big ones. Some people think that the smaller ones are captured asteroids. Orbiting moons are formed by either big chunks breaking off a planet or chunks falling from space, and some spin the reverse of ours.

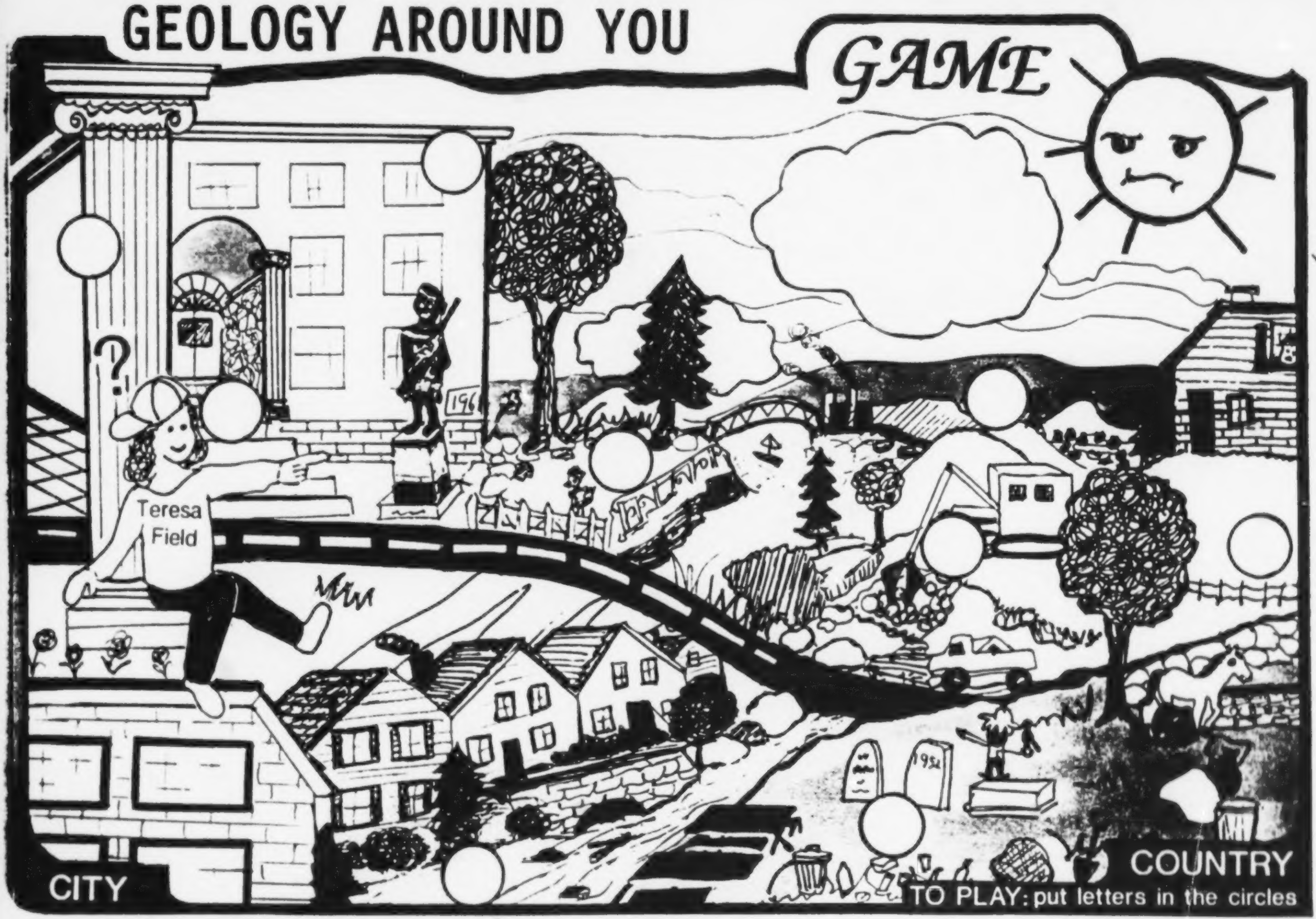
Why do **VOLCANOES** on other planets and moons spew different stuff than ours? Jupiter's moon Io spews sulfur!

What's your theory about these puzzling events?





GEOLOGY AROUND YOU GAME



TO PLAY: put letters in the circles

A **COLUMNS/ARCHES**
Look at the surfaces of these carved rocks. Often they are made from polished slabs of granite or marble. Look to see if they show weathering.
Hints: Dull edges, cracks, pock marks.

B **VALLEYS & HILLS**
When looking down from a cliff or hill, notice the landforms below. Look for any signs of erosion. Can you see water? Where does it collect? Which way does the water flow?

C **CITY PARKS**
Grassy areas allow people in cities to have pretty, natural surroundings. Look for rocks & interesting landforms. Can you find places where animals and plants make their homes?

D **WALLS/FLOORS**
Buildings such as the library, court house, & justice center use beautiful marble and granite. Look for colors and fossils in polished rock slabs.

E **EMPTY FIELDS**
Find a place where you can dig holes to look for rocks & minerals. Check out the color of the soil & watch where the water settles. Go many times & see what changes.

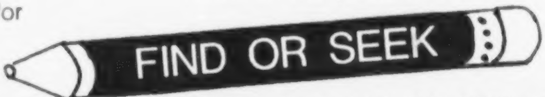
F **CREEKS/RIVERS**
Look for erosion & how the water moves. Lay rocks in streams & watch what happens. Can you make a rock bridge? Is the river straight or wiggly? Go back to see changes.

G **STATUES & GRAVESTONES**
Many of these are made from rocks. These stand up to water because they are strong materials. Look for weathering.
Hints: Words hard to read, corners rounded.

?

H **BUILDING SITES**
When land is cleared, soil becomes exposed. What color is it? Does it look like dynamite was used to clear the land? Look for layers, boulders, or solid rocks in the pit.

I **OLD BUILDINGS**
Find the cornerstone to see when it was built. Look at the edges; any signs of wear?
Hints: cracks, pock marks.



Mystery Game: How many kids' names in this book can you remember?

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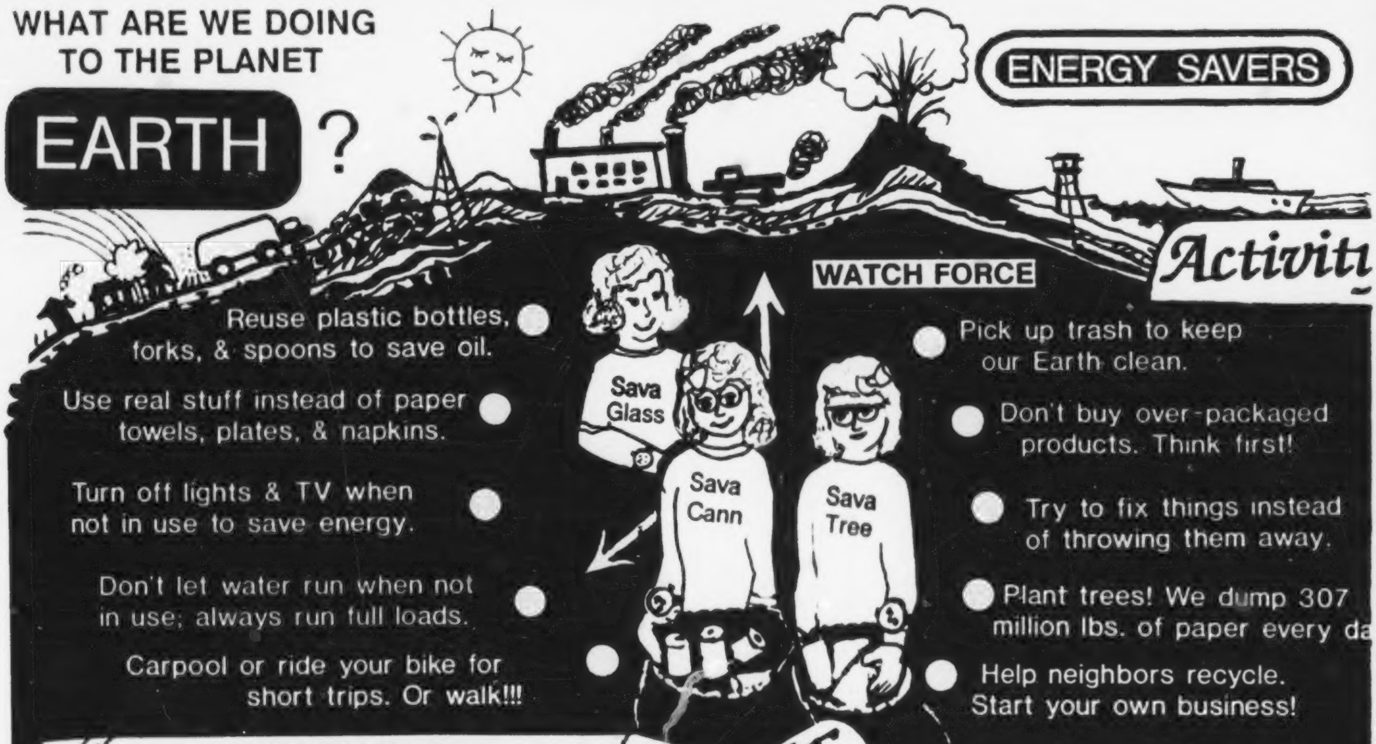
WHAT ARE WE DOING TO THE PLANET EARTH ?

ENERGY SAVERS


Sava Glass
Sava Cann
Sava Tree

WATCH FORCE

Activiti

YOU CAN HELP:

- Reuse plastic bottles, forks, & spoons to save oil.
- Use real stuff instead of paper towels, plates, & napkins.
- Turn off lights & TV when not in use to save energy.
- Don't let water run when not in use; always run full loads.
- Carpool or ride your bike for short trips. Or walk!!!
- Pick up trash to keep our Earth clean.
- Don't buy over-packaged products. Think first!
- Try to fix things instead of throwing them away.
- Plant trees! We dump 307 million lbs. of paper every da
- Help neighbors recycle. Start your own business!

GAME

Watch the news. Read the newspaper. When you learn of an environmental problem, write to let someone know!
Complain
Collin
POLLUTION
chips
pop

SHARE YOUR OPINION!

President ____________
1600 Pennsylvania Ave. NW
Washington, DC 20500

Senator ____________
U.S. Senate
Washington, DC 20510

Representative ____________
U.S. House of Representatives
Washington, DC 20515

State Senator ______
(look yours up & write!
Your State, His/Her Zip

HOW LONG DOES IT TAKE TO DECOMPOSE?
W. WEEKS
M. MONTHS
Y. YEARS

1. Aluminum	200-5
2. Banana peels	1-6
3. Cigarette filters	10-20
4. Cotton clothes	1-5
5. Degradable plastic bag	2-3
6. Disposable diapers	450
7. Glass jars/bottles	1 milli
8. Paper towels	2-4
9. Paper cup	up to
10. Painted wood	13
11. Plastic (anything)	450
12. Railroad tie	30
13. Rope	3-14
14. ®Styrofoam	10-20
15. Tin cans (steel)	100
16. Traffic ticket	2-4
17. Unpainted wood	1-4
18. Wool sock	1

ANSWERS: 5. M 8. M 11. Y 14. Y 17. Y
1. Y 3. Y 6. Y 9. Y 12. Y 15. Y 18. Y
2. M 4. M 7. Y 10. Y 13. M 16. M

Pitch in, the WORLD is worth saving!!!

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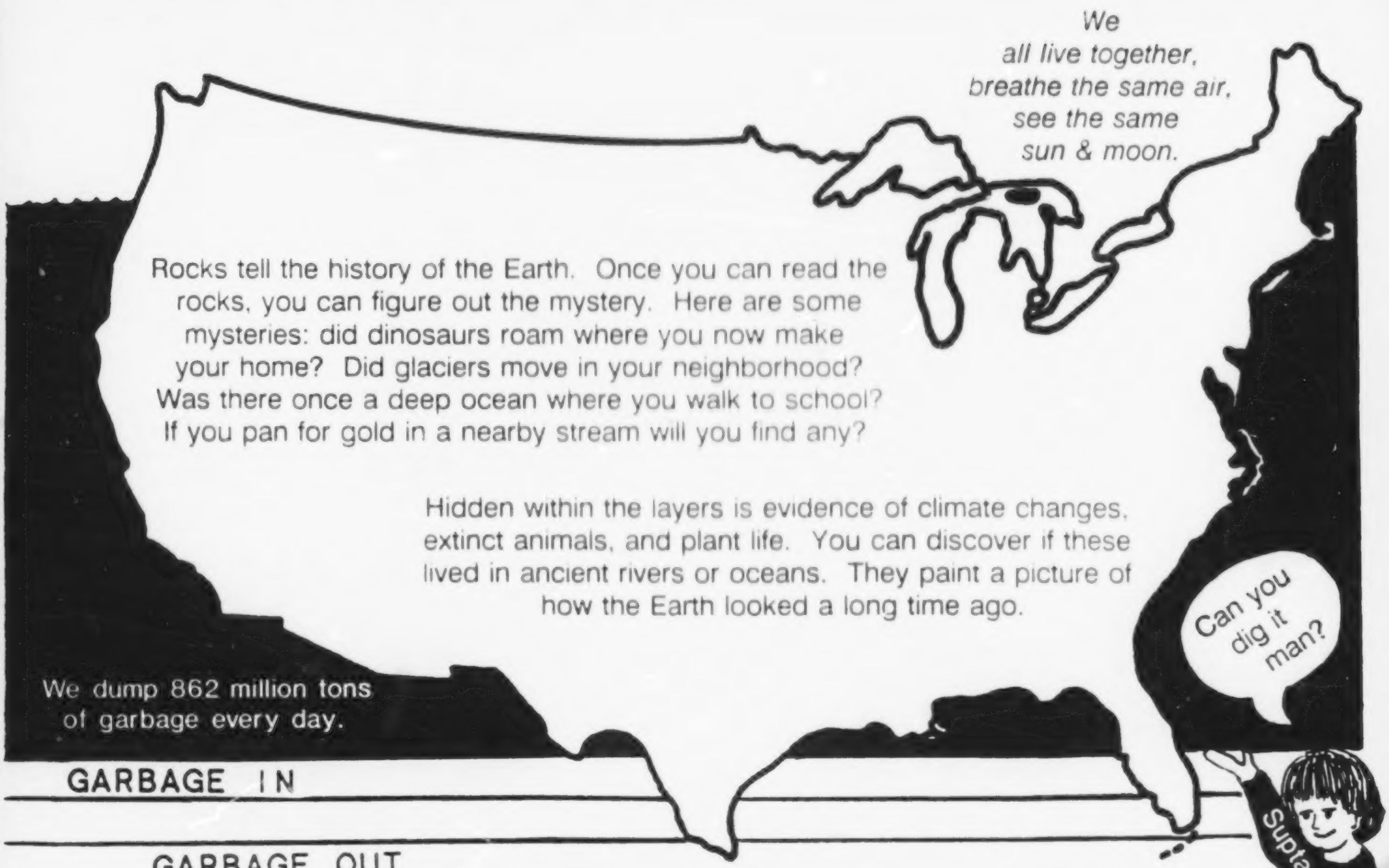

We all live together, breathe the same air, see the same sun & moon.
Can you dig it man?

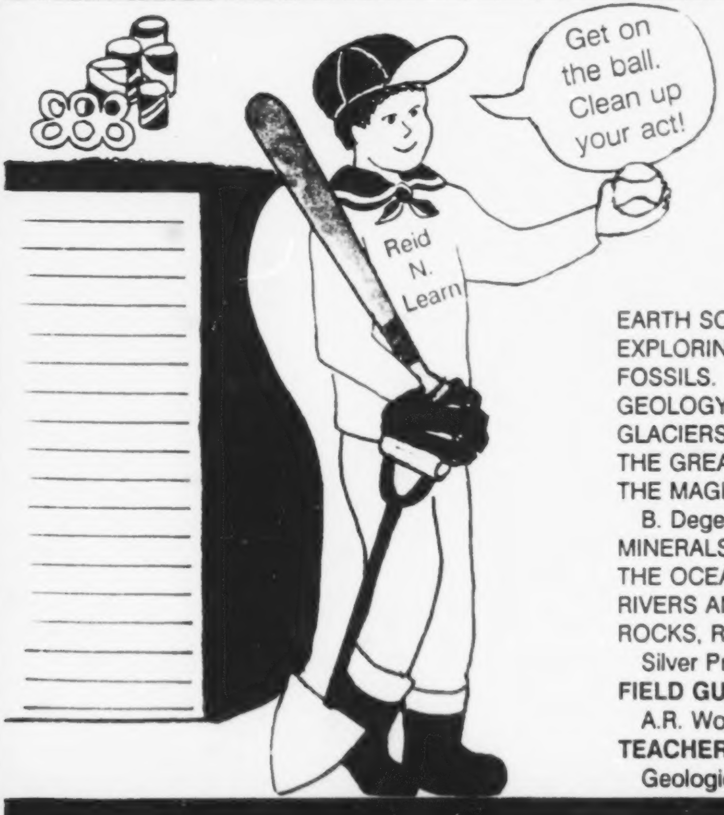
Rocks tell the history of the Earth. Once you can read the rocks, you can figure out the mystery. Here are some mysteries: did dinosaurs roam where you now make your home? Did glaciers move in your neighborhood? Was there once a deep ocean where you walk to school? If you pan for gold in a nearby stream will you find any?

Hidden within the layers is evidence of climate changes, extinct animals, and plant life. You can discover if these lived in ancient rivers or oceans. They paint a picture of how the Earth looked a long time ago.

We dump 862 million tons of garbage every day.

GARBAGE IN

GARBAGE OUT


Get on the ball. Clean up your act!
Reid N. Learn

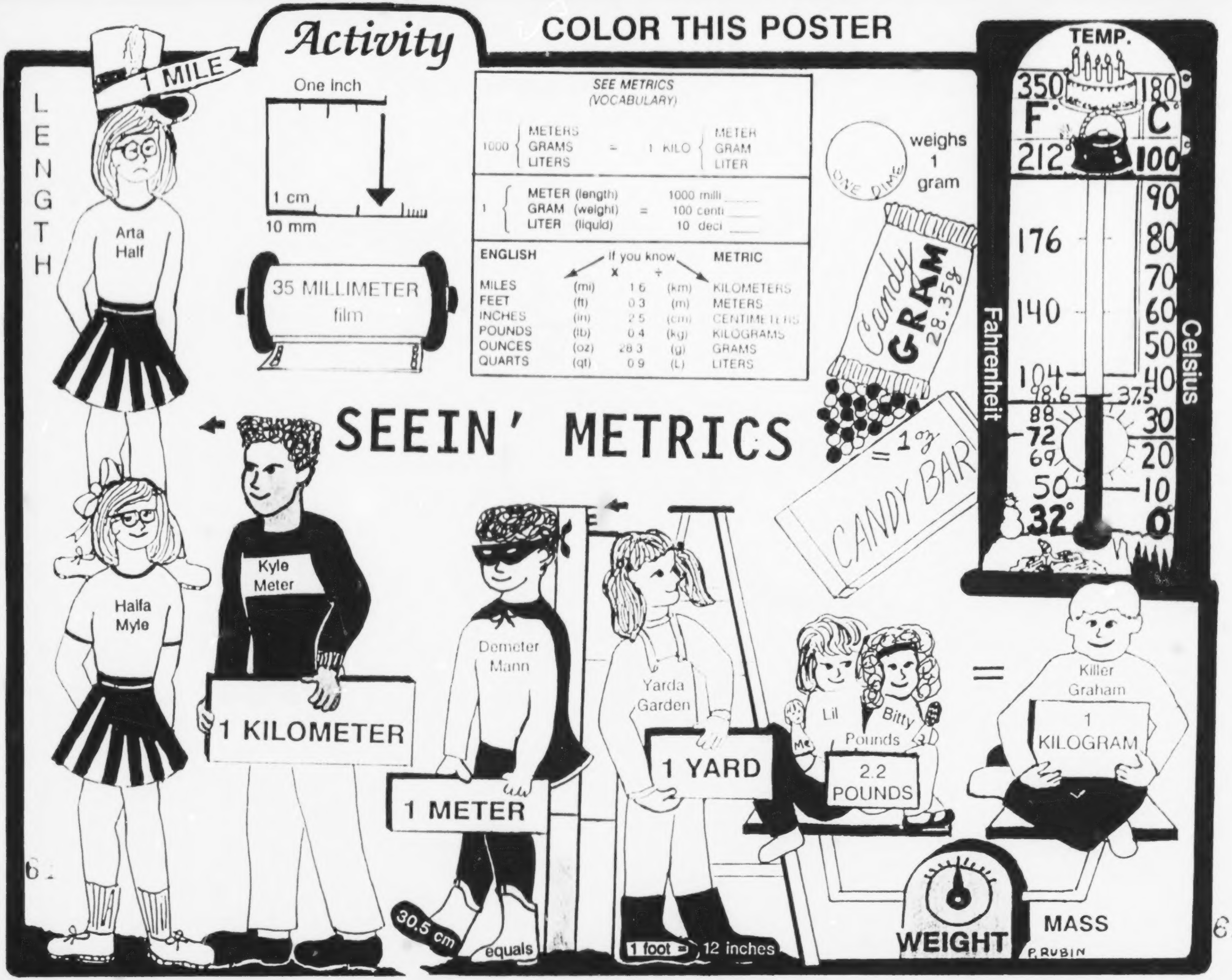
GOOD BOOKS FOR CHILDREN

ADVENTURES WITH ROCKS AND MINERALS-- GEOLOGY EXPERIMENTS FOR YOUNG PEOPLE. 1991. L.H. Barrow. Hillsdale, NJ.
CRYSTALS AND CRYSTAL GARDENS YOU CAN GROW. 1990. J. Strangl. Watts, NY.
DINOSAURS. 1990. J.E. Greenberg and H.H. Carey. Raintree, Milwaukee, WI.
EARTHQUAKES AND VOLCANOES. 1988. D. Lambert. Bookwright, NY.
EARTH SCIENCE FOR EVERY KID. 1991. J. VanCleave. Wiley, NY.
EXPLORING THE SEA. 1986, C. Blair. Random House, NY.
FOSSILS. 1990. P.D. Taylor. Knopf, NY.
GEOLOGY. 1983, D. Dixon. Watts, NY.
GLACIERS. 1988, W.V. Tangborn. Crowell, NY.
THE GREAT ICE AGE. 1987. C. Maynard. Random House, NY.
THE MAGIC SCHOOL BUS INSIDE THE EARTH. 1987, J. Cole and B. Degen. Scholastic. NY.
MINERALS & MAN. 1970, C. Hurlbut, Jr. Random House, NY.
THE OCEANS. 1987. M. Bramwell. Watts, NY.
RIVERS AND LAKES. 1986, M. Bramwell. Watts, NY.
ROCKS, ROCKS BIG AND SMALL. 1990. J. Barkan. Silver Press, Englewood Cliffs, NJ.
FIELD GUIDE. MINERALS, ROCKS, & FOSSILS. 1974. W.R. Hamilton, A.R. Wooley, and A.C. Bishop. H. Holt and Co., NY.
TEACHER PACKET. Request on letterhead to U.S. Geological Survey, Geologic Inquiries Group, 907 National Center, Reston, VA 22092

If we keep dumping garbage, will the Earth still make diamonds?

Activity

COLOR THIS POSTER



SEE METRICS (VOCABULARY)

1000 { METERS, GRAMS, LITERS } = 1 KILO { METER, GRAM, LITER }

1	METER (length)	=	1000 milli	____
	GRAM (weight)		100 centi	____
	LITER (liquid)		10 deci	____

ENGLISH	If you know	x	÷	METRIC
MILES	(mi)	1.6	(km)	KILOMETERS
FEET	(ft)	0.3	(m)	METERS
INCHES	(in)	2.5	(cm)	CENTIMETERS
POUNDS	(lb)	0.4	(kg)	KILOGRAMS
OUNCES	(oz)	28.3	(g)	GRAMS
QUARTS	(qt)	0.9	(L)	LITERS

1 MILE
LENGTH
One inch
1 cm
10 mm
Arta Half
35 MILLIMETER film
SEEIN' METRICS
Halfa Myle
Kyle Meter
1 KILOMETER
Demeter Mann
1 METER
30.5 cm
equals
Yarda Garden
1 YARD
1 foot = 12 inches
ONE DIME
weighs 1 gram
Candy GRAM 28.35g
= 1 oz CANDY BAR
TEMP.
350° F
180° C
212°
100°
176
140
104
98.6
88
72
69
50
32°
90
80
70
60
50
40
37.5
30
20
10
0
Fahrenheit
Celsius
Lil Bitty Pounds
2.2 POUNDS
=
Killer Graham
1 KILOGRAM
WEIGHT
MASS
P. RUBIN

ABOUT THE AUTHORS

PENNI IBERALL RUBIN is an Educational Resource Specialist, educational consultant, freelance writer, and artist. She is currently developing the WONDER Lab Discovery Center in Cleveland, Ohio. She holds a degree in Early Childhood Education/ Childhood Enrichment/ Communications. She has been on the staff of the English Nannies School since 1985. She performs educational programs & writes songs and books, including the "Mommy I Have Nothing To Do" Book; "DO-RE Musical Me"; "Math in Motion"; "Science in the Sandbox and WONDER-ful Stuff"; the "Instead of TV Newsletter"; "Recycle and Build Toys that Build Skills"; and "Crazy Daze" cassette & song book. Penni founded and has directed the Crafty Cuties pre-school Enrichment Centers since 1970. She travels the country presenting PROJECT S.A.M. (Science, Art, & Math) to train primary school educators. She lectures at PTA's and ECED teacher conferences, presenting workshops for those who want to challenge children to develop their creative potential and scientific prowess.

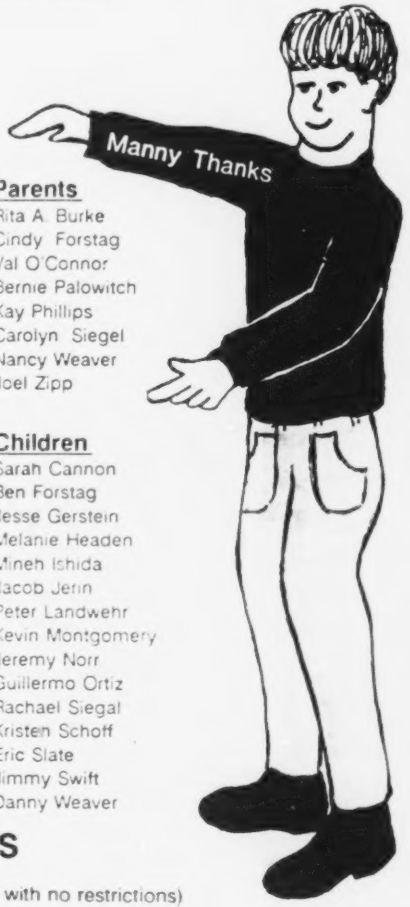
Her sister, **DR. ELEANORA IBERALL ROBBINS,** has been a geologist with the U.S. Geological Survey since 1967. Her degrees in Geology and Geosciences are from Ohio State University, University of Arizona, and Pennsylvania State University. She is the author of more than 100 professional publications, including "Palynology of Ore Deposits." She has travelled extensively around the world, starting from the time she was a Peace Corps volunteer in Tanzania. Eleanora won the U.S. Department of Interior Points of Light award for her volunteer efforts teaching field geology to inner city children in Washington, D.C.

Another sister, Dr. Thea Iberall of C.P. Garth Software, is developing a Macintosh HyperCard stack to supplement this book.

ACKNOWLEDGEMENTS

Gary Hill

Bonnie McGregor   Rob Robinson



Scientists
- Tom Ahlbrandt
- Tau Rho Alpha
- Dave Barna
- Mike Brett-Surman
- Isobelle Brownfield
- Lynn Coleman
- Bruce Cornet
- Phil Davis
- John DeYoung
- Alex Downs
- Terry Edgar
- Art Frankel
- Judy Fretwell
- Bernardo Grossling
- Linda Gunderson
- Jane Hammarstrom
- Carter Hearn
- Arthur Iberall
- Arch Johnston
- Baerbel Lucchitta
- Bob Luedke
- Virginia Major
- Charles Mankin
- Sue Marcus
- Ted Maxwell
- Dick Meyer
- Betty Miller
- Susan Russell-Robinson
- Mike Ryan
- Moto Sato
- Carl Stover
- Michael Tevesz
- Susan Tewalt
- Alta Walker
- Rob Weems
- Richie Williams

Teachers
- Sue Ballinger
- Donald Cammiso
- George Cannon
- Mary Kate Cross
- Christa DeVore
- Roberta Herman
- Nancy Moore
- Anne Schoff
- Katheryn Shaw
- Deborah Tynes

Technical Support
- Frank Dulong
- Nancy Gardner
- Kathleen Gohn
- Joe Graham
- Sharon Harris
- Dave Hockey
- Ann Hoopfer
- Audrey Hwang
- Anna Marcus
- John Keith
- Carole Messick
- Joe Pillera
- Dee Dee Poole
- Mary Queen
- Brian Robbins
- Helene Rubenstein
- Melanie Rubin
- Richard Rubin
- Rory Rubin
- Barbara Schwimmer
- Ron Stanton
- Roger Thomas
- Laure Wallace

Parents
- Rita A. Burke
- Cindy Forstag
- Val O'Connor
- Bernie Palowitch
- Kay Phillips
- Carolyn Siegel
- Nancy Weaver
- Joel Zipp

Children
- Sarah Cannon
- Ben Forstag
- Jesse Gerstein
- Melanie Headen
- Mineh Ishida
- Jacob Jerin
- Peter Landwehr
- Kevin Montgomery
- Jeremy Norr
- Guillermo Ortiz
- Rachael Siegal
- Kristen Schoff
- Eric Slate
- Jimmy Swift
- Danny Weaver

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ANSWERS TO GAMES AND ACTIVITIES: (pgs.)

1. 1.quartz,2.coral,3.dino,4.urchin,5.dino print,6.sea animal,7.either
7. All statements are TRUE
8. 1.ropy,2.tears,3.bomb,4.pumice,5.obsidian
17. Atlantic,Mississippi,Appalachian,GREAT
18. 26°/199°
20. ABCDEFGHIJ
32. 1.silver,2.oil,3.coal,4.gold,5.diamonds
33. pterodactyl,Apato, Stego, Tricera, Dimetrodon,T.rex
34. clockwise from left, c,c,a,c,c,e,d,e,f,g
    1.P,2.A,3.A,4.A,5.P,6.?,7.A,8.A,9.P
38. See pgs.4 or 36 for continents;1.Mercury,2.Venus,3.Earth,
    4.Mars,5.Jupiter,6.Saturn,7.Uranus,8.Neptune,9.Pluto

TAKE
PRIDE IN
AMERICA

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U. S. Administration.

March 3, 1849

U.S. GEOLOGICAL SURVEY

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